Anderson Mulholland & Associates
ENVIRONMENTAL CONSULTANTS

December 28, 2006

Mr. Dale Carpenter, Chief
Caribbean Section
RCRA Programs Branch
U.S. Environmental Protection Agency, Region II
290 Broadway
New York, New York 10007-1866

RE: Final Human Health Risk Assessment
TAPI Puerto Rico, Inc., Guayama, Puerto Rico
EPA ID No.: PRD090613357

Dear Mr. Carpenter:

On behalf of TAPI Puerto Rico, Inc., enclosed please find two copies of the Final Human Health Risk Assessment (HHRA) for the two hazardous waste incinerators located at the TAPI manufacturing facility located in Guayama, Puerto Rico. The HHRA incorporates the results of the stack testing conducted during the Comprehensive Performance Test completed in April 2006.

The Final HHRA demonstrates that the human health hazards and risks associated with point source emissions from TAPI's hazardous waste incinerators and fugitive emissions from hazardous waste storage tanks and equipment are within acceptable guidelines established by EPA.

Please feel free to call if you have any questions.

Sincerely,

Herbert F. Mulholland, P.E.

cc: A. Tirado, TAPI
G. Mendez, Goldman Antonetti
A. Fuentes, PREQB

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Human Health Risk Assessment: Hazardous Waste Combustor

TAPI Puerto Rico, Inc. Guayama, Puerto Rico

December 2006

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Abbreviations and Acronyms

AIEC	Acute inhalation exposure criteria
amsl	Above mean sea level
cm/yr	Centimeters per year
COPC	Compound of potential concern
CPT	Comprehensive Performance Test
EPA	U.S. Environmental Protection Agency
ESL	Ecological screening level
ESV	Ecological Screening Value
$g/m^2/yr$	Grams per square meter per year
g/cm^3	Grams per cubic centimeter
g/s	Grams per second
HEAST	Health Effects Assessment Summary Tables
HHRA	Human health risk assessment
HHRAP	Human Health Risk Assessment Protocol
HI	Hazard index
HQ	Hazard quotient
IRIS	Integrated Risk Information System
km	Kilometer
km^2	Square kilometers
m	Meter
mg/kg	Milligrams per kilogram (ppm)
mg/kg/day	Milligrams per kilogram per day
NA	Not available
ng/dscm	Nanograms per dry standard cubic meter
NOAA	National Oceanic and Atmospheric Administration
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated-dibenzo-dioxin
PCDF	Polychlorinated-dibenzo-furan
PIC	Product of incomplete combustion
PREQB	Puerto Rico Environmental Quality Board
RfC	Reference concentration (noncancer)
RfD	Reference dose (noncancer)
SF	Slope factor (carcinogenic)
TAPI	TAPI Puerto Rico, Inc.
TCDD	2,3,7,8 tetrachloro-dibenzo-dioxin
TEF	Dioxin/furan toxicity equivalent factor
TEQ	Dioxin/furan toxicity equivalent
TIC	Tentatively identified compound

TOE	Total Organic Emissions
ug/L	Micrograms per liter
ug/m^3	Micrograms per cubic meter
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal transverse mercator

1.0 Introduction

TAPI Puerto Rico Inc. (TAPI) has completed a Human Health Risk Assessment (HHRA) of the hazardous waste incinerators operated at its manufacturing facility located in Guayama, Puerto Rico. The TAPI facility was formerly known as API Industries, Inc. and, prior to 2002, as Chemsource Corporation. The HHRA was conducted as required by the U.S. Environmental Protection Agency, Region 2 (EPA), in accordance with EPA's *Resource Conservation and Recovery Act Site-Specific Risk Assessment Policy for Hazardous Waste Combustion Facilities* (EPA, 2000). This Final HHRA is a revision of the Preliminary Human Health Risk Assessment Report submitted to EPA in January 2003 (ERM, 2003).

TAPI operates two liquid-injection hazardous waste incinerators for the treatment of aqueous and organic hazardous waste generated in TAPI's manufacturing process. The incinerators, referred to as the Trane 1 and Trane 2 units, operate in accordance with RCRA Permit No. PRD090613357. Combustion gases from the two incinerators are emitted through a common stack. The two incinerators are thus classified as a single affected source under 40 CFR Part 63. Comprehensive performance testing (CPT) was conducted on the incinerators in April 2006 in accordance with 40 CFR §63.1208. Testing demonstrated that the incinerators achieve compliance with all applicable final HWC MACT emission standards. A Notification of Compliance (NOC) was submitted to PREQB in July 2006 which sets forth waste feed and incinerator operating limits to ensure continuous compliance with MACT standards.

The objective of this HHRA is to demonstrate that operation of the hazardous waste incinerators and associated RCRA hazardous waste storage tanks and equipment do not pose unacceptable risk to human health. The methodology employed in conducting the HHRA is consistent with that presented in *Human Health Risk Assessment Protocol for Hazardous Waste Combustor Facilities* (EPA, 2005), hereinafter referred to as HHRAP. The HHRA addresses direct and indirect exposure to incinerator stack emissions as well as fugitive emissions from RCRA tanks and equipment. Both carcinogenic risk and non-carcinogenic hazards were evaluated for all exposure scenarios.

Risk calculations were performed with the Industrial Risk Assessment Program - Human Health software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006), which estimates COPC media concentrations, intakes, risk, and hazard in accordance with the HHRAP

guidance. Lakes Environmental Software reports that the software has been validated by EPA Regions 4 and 6.

A summary of the organization of the remainder of the HHRA is presented below:

- Section 2 describes the site setting, compounds of potential concern (COPCs), and emission rates.
- Section 3 describes the air dispersion modeling used to simulate dispersion and deposition of COPCs emitted from the incinerator and ancillary facilities.
- Section 4 identifies the receptors and exposure pathways considered in the HHRA.
- Section 5 describes the methodology for estimating the concentration of COPCs in various media.
- Section 6 describes the methodology for quantifying the exposure of various receptors to COPCs.
- Section 7 describes cancer risks, non cancer hazards, and additive risks associated with COPCs.
- Section 8 presents the results of the HHRA including quantitative estimation of cancer risk and non-cancer hazard.
- Section 9 describes uncertainties associated with the risk assessment process.
- Section 10 provides the results of a qualitative evaluation of impacts to ecological receptors.
- Section 11 presents a summary of HHRA conclusions.
- Section 12 presents references.

2.0 Characterization of Facility Emissions

This section provides information on the nature and magnitude of emissions from the TAPI facility. Included are sections on facility information, sources of emissions, compounds of potential concern, and emission rates.

2.1 Facility Information

2.1.1 Facility Setting

The TAPI facility is located at State Road No. 3, km 143, in Guayama, Puerto Rico. A site location map is presented in Figure 2-1. The 45-acre property comprises two areas. Twenty-five acres have been developed for industrial purposes. The remaining land is undeveloped and is reserved for future industrial development. The Phillips Petroleum Refinery is located to the east of the TAPI property. The AES Puerto Rico electric cogeneration facility is located to the south and east. Undeveloped land is adjacent to the property to the north and west.

The Town of Guayama is located approximately 5 km to the northeast and Puente Jobos Ward is located approximately 1.5 km to the northwest of the facility. An EPA Superfund site (Fibers Public Supply Wells) is located approximately one mile to the northeast. Further discussion of surrounding land use is presented in Section 4.1.

The TAPI facility is located on the southeastern coastal plain of Puerto Rico. The facility is about 2 km north of the Caribbean Sea and 7 km south of the foothills of the Cordillera Central Mountains. The topography of the coastal plain slopes gently to the south and varies from about 150 ft above mean sea level (amsl) where it abuts the mountain foothills to sea level. The mountains reach elevations of almost 3000 feet amsl about 6 miles north of the facility. The topography at the facility area is relatively smooth and slopes to the south from about 20 to 13 ft amsl.

With the exception of coastal lagoons and channels, surface water in the immediate vicinity of the facility is scarce. Two ephemeral creeks of limited extent that flow to the southwest are situated about 0.75 and 1.25 km west of the facility boundary. The closest major rivers are Rio Guamaní and Rio Seco which flow generally north to south and are located 1.25 and 2 km to the east and west of the facility, respectively. The Canal de Patillas, a man-made surface water

channel, flows from east to west and is located about 4 km north of the facility. Las Mareas Bay, an artificial body of water that resulted from dredging in 1968, lies approximately 1 km south of the facility. Mangrove areas occur to the west of the facility. Bahia de Jobos, an inlet of the Caribbean Sea, is located approximately 2 km west of the facility.

Available hydrogeologic information relating to the facility area indicate the occurrence of two water-bearing zones: a shallow water table water-bearing zone and a lower aquifer zone. Both of these zones occur within the coastal plain alluvial deposits. Based on a soil foundation study performed in 1979 at the southeast area of the facility, the uppermost water-table zone has a depth to water of about 5 ft bgl, although its depth over the facility may vary by several feet, mainly due to topographic variations. The flow direction in the shallow water-table zone is to the south.

Groundwater elevation maps for the lower aquifer in the area of the facility show that the groundwater flow direction is to the south. Additionally, regional groundwater levels, which range from about 150 to 200 ft amsl near the bedrock-alluvial contact in the north to a few feet amsl in the south near the coast, indicate that the regional groundwater flow is seaward to the south. Groundwater in the region has been developed extensively. The production wells at the TAPI facility draw water from the lower aquifer zone.

2.1.2 Facility Operations

TAPI manufactures bulk active pharmaceutical ingredients. Facility operations include chemical manufacturing processes with related support operations. The primary structures on-site include four separate bulk chemical manufacturing process plants, laboratory facilities, warehouses, a process wastewater treatment facility, and administrative and other support buildings. The three main manufacturing buildings are identified as Guayama I, II, and III. One section of the Guayama III building is a Pilot Plant, which is called Guayama IV. The TAPI facility also includes a RCRA hazardous waste storage and incineration area. A facility site map is presented in Figure 2-2.

The facility was initially developed for pharmaceutical operations in 1978 by SK&F Lab Company (SKF), a subsidiary of Smith Kline Beecham Chemical Division. Prior to 1978, the land was undeveloped.

2.1.3 Hazardous Waste Management Activities

Hazardous wastes that are subject to regulation under RCRA are generated as part of the TAPI pharmaceutical manufacturing process. These wastes include organic and aqueous process waste, organic and inorganic laboratory reagents, material residues from maintenance and cleanup operations, and other waste materials.

TAPI operates under RCRA Permit No. PRD090613357 which allows the management of hazardous waste in twelve regulated waste management units, as described below. The locations of the waste management units are presented in Figure 2-2.

- TAPI is equipped with three hazardous waste incinerators at the facility. Only two of the incinerators, Trane 1 and 2, are operational. The third unit, Trane 3, has been removed from service and will not be restarted. TAPI is not seeking renewal of the RCRA Permit for this unit. The operating incinerators manage organic and aqueous process and laboratory waste generated at the facility. The incinerators are further described in Section 2.2.1.

- TAPI is permitted to operate eight above ground tanks for the storage of hazardous waste. The tanks range in size from 5,200 to 20,000 gallons. The tanks manage organic and aqueous process and laboratory waste. The tanks are further described in Section 2.2.2.

- TAPI operates a container storage area for the management of containers of hazardous waste prior to off-site disposal.

In addition to the tanks described above, TAPI operates two above ground tanks for the storage of hazardous waste for periods less than 90 days. These tanks are further described in Section 2.2.2

TAPI is permitted to manage hazardous wastes classified under 40 CFR 261.32 as F001, F002, F003, F005, and D001 in its hazardous waste management facilities. Quantities of hazardous waste managed in the units are described in Sections 2.2 and 2.4. Constituents that may be present in the hazardous waste managed in tanks and incinerators are identified in Section 2.3.

2.2 Identification of Emission Sources

This section provides a description of emission sources at the TAPI facility. Emission sources include the hazardous waste incinerators, hazardous waste storage tanks, and hazardous waste equipment.

2.2.1 Hazardous Waste Combustor Stack Emissions

The Trane 1 and Trane 2 incinerators are Sub-X Liquid Waste Oxidizers manufactured by the Trane Thermal Company of Conshohocken, Pennsylvania. Gases from the Trane 1 and Trane 2 incinerators are exited to the atmosphere through one common stack. Trane 1 was installed in 1977 and Trane 2 was installed in 1979. A simplified process flow diagram of the Trane 1 and Trane 2 incinerators is presented in Figure 2-3. The locations of the incinerators and the common incinerator stack (designated as Point Source 02) are shown in Figure 2-4.

The units are down fired liquid waste incinerators essentially identical in design, construction, and operation. The incinerator system consists of a combustion chamber and associated air pollution control equipment (APCE). The Trane 1 and Trane 2 incinerators are permitted to treat hazardous and non-hazardous liquid wastes. The waste is injected to the combustion chamber via two ultrasonic atomizing nozzles directly into the flame zone of the incinerator to achieve a high destruction efficiency. Kerosene is used as an auxiliary fuel in order to maintain combustion chamber temperature. The combustion chamber and associated APCE achieves a minimum of 99.999% destruction and removal efficiency for organic hazardous air pollutants.

The APCE associated with the incinerators are the quench tank, high-energy venturi scrubber, and a common wet electrostatic precipitator (WESP). Most of the particulate matter is removed by the quench tank. Fine particulate matter is removed at the venturi scrubber and WESP. The APCE is designed to achieve applicable emission standards for inorganic hazardous air pollutants. HCl/Cl_2 emissions standards are achieved by maintaining a minimum pH in the quench tank and high-energy venturi scrubber by automated addition of caustic soda.

Stack gases are continually monitored for carbon monoxide (CO) and oxygen (O_2). The incinerator stack is equipped with a Continuous Emission Monitor (CEM) for CO/O_2. The units are also equipped with a continuous monitoring system (CMS) to monitor and record operating conditions at various points in the system. In the event that any critical parameter falls outside of the indicated operating conditions, one of several interlock protocols will be triggered. The

respective automatic waste feed cut-off (AWFCO) system will then be initiated, ensuring that the incineration of hazardous waste will cease, thereby ensuring that the incinerator operates in a "fail safe" mode.

A Comprehensive Performance Test (CPT) was performed on the Trane 1 and Trane 2 Incinerators by TRC Environmental Corporation, Raleigh, North Carolina in accordance with the requirements of 40 CFR §63.1207. Testing was conducted in accordance with a CPT Test Plan that was approved by EPA and EQB (AMAI, 2005). Testing of the Trane 1 and Trane 2 units was conducted in March and April 2006. The objectives of the CPT were to demonstrate that the incinerators achieve compliance with HWC MACT emission standards set forth at §63.1203 and to establish limits for operating parameters set forth at §63.1209. The CPT also gathered emission data for use in this HHRA, including removal efficiencies for selected metals and emission rates of products of incomplete combustion (PICs). Stack testing of the Trane 1 and Trane 2 units was conducted under worst case waste feed and operating conditions to demonstrate compliance with emissions of hydrochloric acid/chlorine gas, particulate matter, CO, HC, and dioxin/furan as well as for destruction/removal efficiency of principal organic hazardous constituents, lead, chromium, and arsenic. The CPT demonstrated that the Trane 1 and Trane 2 units successfully achieve compliance with all final emission standards for which they were tested (TRC 2006).

A Notification of Compliance (NOC) was submitted to EPA in July 2006 in accordance with 40 CFR §63.1210(b). Operating limits were established for the combustion chamber and air pollution control equipment and feed rate limits were determined for ash, chlorine, and metals. A copy of the NOC text and tables is presented on a CD included as Appendix A. The NOC provides additional information on incinerator and APCE design, applicable emission standards, incinerator operating conditions, and waste feed limitations.

2.2.2 RCRA Fugitive Emissions from Tanks

Under the provisions of its RCRA Permit, TAPI is authorized to operate eight existing tanks for the storage of hazardous waste prior to incineration. TAPI also operates two tanks for the storage of hazardous waste for periods less than 90 days. All tanks are aboveground, fixed roof tanks of steel construction. Tank sizes range from 5,200 gallons to 20,000 gallons. In addition to these ten existing tanks, TAPI has requested a permit to build an additional 20,000 gallon storage tank. The locations of the tanks are shown in Figure 2-4. Further detail on the design, construction, and operation of the tanks is presented in Section 2.4.2.

This HHRA addresses risks associated with fugitive emissions of organic compounds from the ten existing and one proposed tank. Fugitive emissions occur as working and breathing losses. Fugitive emissions from all tanks are, or will be, conveyed via a closed vent system from the tank roof to a scrubber for treatment prior to emission to the atmosphere. The location of the scrubber (designated as Point Source 01) is presented in Figure 2-4. The elevation of the top of the scrubber at the point at which vapors are emitted is 35 ft above ground level. The scrubber is intended to reduce odors associated with emissions. Any reduction in concentrations of organic compounds in scrubber emissions is incidental. For the purposes of this risk assessment, zero removal efficiency of organic compounds is conservatively assumed for the scrubber.

2.2.3 RCRA Fugitive Emissions from Equipment

The HHRA addresses risks associated with fugitive emissions of organic compounds from process equipment that comes into contact with hazardous waste. In conformance with the requirements of 40 CFR 265 Subpart BB, TAPI has prepared an inventory of such equipment as the basis for their leak detection and repair program. Equipment includes pumps, valves, mixers, connectors, and flanges associated with incinerators and hazardous waste storage tanks. For tanks not currently operable and for the proposed new tank, the equipment inventory is assumed to be the same as that of an equivalent sized tank. The equipment inventory is discussed further in Section 2.4.3.

To facilitate dispersion modeling of fugitive emissions, equipment has been grouped into four combined source areas based on proximity to associated tanks or incinerators. These area sources are shown in Figure 2-4 and are described below:

- Area Source 01 includes equipment associated with the two incinerators as well as tanks V-401, V-406, V-408, and V-430.
- Area Source 02 includes equipment associated with tanks V-450, V-451, V-452, and V-453 as well as proposed tank V-454.
- Area Source 03 includes equipment associated with tank V-436.
- Area Source 04 includes equipment associated with tank V-604.

2.3 Compounds of Potential Concern

This section describes the selection of compounds of potential concern (COPCs) for evaluation in the risk assessment.

2.3.1 Organic Compounds

The methodology employed in selecting organic COPCs for quantitative evaluation of risks is presented below. The six step procedure is consistent with the approach recommended by EPA in HHRAP.

- Step 1 - The Comprehensive Performance Test (CPT) included stack testing for a comprehensive list of organic compounds that may be present in stack gas as products of incomplete combustion (PICs) or reformation products in accordance with EPA guidance and the EPA and EQB-approved CPT Plan. Any organic compound detected in stack gas during any run of the CPT is included in this HHRA as a COPC with the exception of dimethyl phthalate. These compounds are identified in Table 2-1. Dimethyl phthalate is not associated with facility operations and there is no apparent mechanism for phthalate PICs to be formed by burning other chemical compounds as discussed in HHRAP. Dimethyl phthalate is therefore assumed to be a laboratory contaminant and is excluded as a COPC. Appendix B includes an electronic copy of the text and tables of the CPT Report which provide detailed information on test protocols and test results.

- Step 2 - An organic compound not detected in stack gas during the CPT is selected as a COPC if it is reported to have been detected in historical waste analyses or if it is known or suspected to be used in the manufacturing process. These compounds are identified in Table 2-1. However, any such compound is excluded as a COPC if is not identified as either a hazardous constituent at 40 CFR 261 Appendix VIII or as a hazardous air pollutant (HAP) under the Clean Air Act as indicated in Table 2-1. By eliminating organic compounds that were not detected in stack gas during the CPT under worst case conditions, and are not identified as either a hazardous constituent or a HAP, this HHRA will focus on those COPCs most likely to pose a risk to human health as a result of operation of the incinerators.

- Step 3 - The waste feed and manufacturing process were evaluated for the presence of organic compounds that were not detected in stack gas but have a high potential to be

emitted as a PIC. It was concluded that, due to the extremely high destruction and removal efficiency demonstrated during the CPT (greater than 99.999%), the potential for any such emission is very low. Accordingly, no additional COPCs have been included for evaluation due to high potential for PIC formation.

- Step 4 - Site specific factors were evaluated for the potential presence of organic compounds that were not detected in stack gas but have a potential to be emitted as a PIC. No site-specific factors such as high background concentrations or other regional concerns were identified that would justify the inclusion of such a COPC. Accordingly, no COPCs have been included due to site-specific factors.

- Step 5 - Human health toxicity data was researched to identify available compound specific human health benchmarks. Benchmarks were identified for all organic compounds retained as COPCs.

- Step 6 - CPT analytical results were evaluated for the presence of tentatively identified compounds (TICs) obtained during gas chromatography analysis. TICs were identified for qualitative assessment in the Uncertainties section of this HHRA. The assessment of TICs is discussed further in Section 10 of this HHRA.

Based on the above criteria, the list of organic COPCs retained for quantitative evaluation throughout this HHRA is presented in Table 2-2. Calculation of emission rates from various sources for these COPCs is discussed in Section 2.4.

2.3.2 Metals

TAPI has conservatively assumed that all metals regulated under the Boiler and Industrial Furnace (BIF) rules at 40 CFR §266.106 may be present in the incinerator waste feed at some time during the operating life of the incinerators. Accordingly, all ten BIF metals are included in this HHRA. BIF metals include the carcinogens arsenic, beryllium, cadmium, and chromium and the non-carcinogens antimony, barium, lead, mercury, silver, and thallium. It is conservatively assumed that the chromium in stack gas occurs as hexavalent chromium. In addition to the ten BIF metals, nickel, selenium, and zinc are being included in the HHRA as recommended by HHRAP.

The list of metals included for quantitative evaluation throughout this HHRA is presented in Table 2-2. Calculation of emission rates from various sources for these COPCs is discussed in Section 2.4.

2.4 Estimation of Emission Rates

Estimated emission rates of COPCs from the incinerator stack, tanks, and equipment are developed in this section.

2.4.1 Hazardous Waste Incinerator Stack Emissions

2.4.1.1 Organic COPCs Detected in Stack

During the CPT, stack testing was conducted for PICs and reformation products during Test Condition 1 which was conducted under low temperature conditions. The test condition consisted of four replicate runs. During each run, stack gas was tested for VOCs, SVOCs, dioxin/furans, PCBs, and aldehydes. Emission rates for individual COPCs detected in stack gas are based on the highest measured emission rate of the four runs. The test protocol and stack sampling results are presented in the CPT Report, an electronic copy of which is included as Appendix B.

Emission rates for COPCs have been adjusted to account for process upsets. Due to the design of the incinerators, operation under process upset conditions is not possible. Interlocks are established to automatically cut off waste feed to the combustion chamber instantaneously when incinerator operating conditions approach allowable operating limits, thus preventing the introduction of waste feed during process upsets before allowable operating conditions can be exceeded. However, TAPI is conservatively assuming that the incinerators are operating under upset conditions 2% of the time. An upset factor of 1.18 is applied to all measured and calculated stack emission rates. This upset factor was derived as per HHRAP guidance using the following formula. It is assumed that emissions during upset conditions (2% of the time) are 10 times emissions during normal conditions (98% of the time).

$$(0.98)(1) + (0.02)(10) = 1.18$$

Estimation of emission rates for COPCs detected in stack gas are discussed below.

- Dioxin/furans - Stack gas was tested for 17 dioxin-like PCDD/PCDF congeners. Table 2-3 presents the highest measured emission rate for each congener, the test run during which the highest emission rate occurred, and the adjusted emission rate considering process upsets. Table 2-3 also provides the toxicity equivalency factor (TEF) and calculates a toxic equivalent (TEQ) emission rate for each congener.

- Coplanar PCBs - To determine carcinogenic risks associated with PCB emissions, stack gas was tested for 12 dioxin-like coplanar PCB congeners. Table 2-4 presents the highest measured emission rate for each congener, the test run during which the highest emission rate occurred, and the adjusted emission rate considering process upsets. Table 2-4 also provides the toxicity equivalency factor (TEF) and calculates a toxic equivalent (TEQ) emission rate for each PCB congener. Coplanar PCBs not detected in stack gas are excluded from the risk assessment as COPCs because they would not reasonably be expected to be present in stack gas under normal operations if not present during the worst case conditions of the CPT.

- Total PCBs - To determine non-carcinogenic hazards associated with PCB emissions, stack gas was tested for total PCBs. Table 2-5 presents the highest measured emission rate for each class of PCBs, the test run during which the highest emission rate occurred, and the adjusted emission rate considering process upsets. PCB classes not detected in stack gas are excluded from the risk assessment as COPCs because they would not reasonably be expected to be present in stack gas under normal operations if not present during the worst case conditions of the CPT.

- SVOCs and Aldehydes - Stack gas was tested for SVOCs and aldehydes. Table 2-6 presents the highest measured emission rate for each compound detected, the test run during which the highest emission rate occurred, and the adjusted emission rate considering process upsets.

Estimation of emission rates of VOCs detected in stack gas during the CPT that are normal components of waste feed (i.e., acetone and methylene chloride) is based on expected concentration in waste feed and demonstrated destruction and removal efficiency as discussed in the following section. This is a conservative approach since the calculated emission rates for

acetone and methylene chloride discussed below are greater than the emission rates measured during the CPT.

2.4.1.2 Organic COPCs in Waste Feed

Remaining organic COPCs include those that may be present in incinerator waste feed which are classified as either hazardous constituents or hazardous air pollutants as indicated in Table 2-1. These COPCs include acetone, methylene chloride, toluene, xylene, chloroform, and methanol. Maximum theoretical emission rates for these COPCs were calculated based on projected feed rates to the incinerator and demonstrated destruction and removal efficiency in the combustion chamber and air pollution control equipment. The methodology employed is summarized below.

- The maximum theoretical feed rate of each COPC was determined based on the concentration of the COPC in waste feed and the annual average waste feed rate to the incinerator. Concentrations of COPCs in organic and aqueous feed rates are presented in Table 2-7. The annual average organic and aqueous feed rates are presented in Table 2-8. This information was provided by TAPI based on past and projected operations.

- A destruction/removal efficiency of 99.999% was applied to each organic COPC based on the results of the Comprehensive Performance Test (see Table 2-4 of Appendix B).

- The resultant emission rate was determined for each organic COPC. The emission rate was then adjusted to account for process upsets. Estimated emission rates are presented in Table 2-8.

2.4.1.3 Metals

Emission rates for metals were estimated by calculating theoretical emission rates based on maximum allowable metal feed concentrations, the annual average waste feed rate to the incinerator, and demonstrated metals removal efficiency in air pollution control equipment. The methodology employed is summarized below.

- A maximum allowable incinerator feed concentration was established for each of the 13 metals evaluated in this risk assessment as presented in Table 2-9. Metal concentrations in aqueous and organic waste are assumed to be the same.

- Metal feed rates were calculated based on the annual average waste feed rate as presented in Table 2-9 to the incinerator which was provided by TAPI based on past and projected operations.

- Removal efficiencies were applied based on the results of the Comprehensive Performance Test (see Table 6-3 of Appendix B). Removal efficiencies were applied by volatility class as per EPA guidance (EPA, 2001a) as follows:

  - For non-volatile metals chromium, beryllium, and nickel, a removal efficiency of 97.6% was applied based on a removal efficiency of 97.6% of chromium during the CPT.

  - For semi-volatile metals lead, cadmium, arsenic and zinc, a removal efficiency of 99.4 % was applied based on a removal efficiency of 99.4% of lead during the CPT.

  - No removal efficiencies were assumed for antimony, barium, selenium, silver, and mercury.

- A resultant emission rate was calculated for each metal. The emission rate was then adjusted to account for process upsets. Estimated emission rates are presented in Table 2-9.

- For each metal, a corresponding maximum allowable feed rate (lbs/hr as a 12-hr rolling average) will be calculated based on the maximum concentration for that metal as well as the maximum allowable waste feed rate as presented in the Notification of Compliance (see Table 2 of Appendix A). These feed rates will be incorporated into TAPI's RCRA Permit to ensure continuous compliance.

2.4.2 RCRA Fugitive Emissions from Tanks

Fugitive emission rates of organic COPCs from TAPI's hazardous waste storage tanks were estimated using TANKS Storage Tank Emissions Calculation Software, Verison 4.0 (EPA, 1999a). The methodology employed is presented below. As described in Section 2.2.2, all losses from hazardous waste storage tanks are conveyed via a closed vent system from the tank roof to a scrubber which has been designated as Point Source No. 01. Therefore, fugitive emissions from

tanks will be modeled as a point source rather than an area source. Point source No. 01 is described further in Section 3. Because the scrubber serves as an odor control device and for neutralization of acid gases and is not designed to reduce the concentration of organic compounds, it is assumed that all fugitive emissions generated in the tanks as described below are released to the atmosphere at Point Source No. 01.

- For each of the ten existing and one proposed tank, information on tank design and operation was input into the computer model. All tanks are classified as vertical fixed roof tanks with cone roofs. Input values for each tank are presented in Table 2-10. Tank information was based on the following:

  - Tank design information (shell and roof characteristics) was obtained based on review of design drawings and field verification.
  - Tank operating information (tank service, net throughput, breather vent settings) was obtained from facility engineering and operations personnel. Values for turnovers per year and average liquid height were calculated based on design and operating information gathered. Calculation of these values is presented in Table 2-11.
  - Information on tank and roof condition was obtained through a visual inspection of the tanks.

- Site information was input for the city of Guayama, Puerto Rico, including daily average ambient temperature, the annual average minimum and maximum temperatures, the annual average wind speed, the annual average insolation factor, and the atmospheric pressure. These values were obtained from the TANKS Data/Meteorological Database.

- For each tank, information on the liquid stored in the tanks was input. Liquids were classified as single-component organic liquids. Chemical composition of aqueous waste and organic waste was input in accordance with the chemical composition of each waste as presented in Table 2-7.

- Based on the above input, TANKS calculates fugitive emissions. Table 2-12 presents the total fugitive emission rate, by tank, including both working and breathing losses. Table 2-13 provides the speciated emission rate for each organic COPC by tank. Appendix C provides TANKS output including the "brief" report format which provides the speciated

emission rates for each tank and the "detailed" report which provides input as well as output values for each tank.

2.4.3 RCRA Fugitive Emissions from Equipment

Fugitive emission rates of organic COPCs from area sources resulting from equipment leaks associated with TAPI's hazardous waste storage tanks and incinerators were estimated based on the actual results of TAPI's leak detection and repair program as required by 40 CFR 265 Subpart BB. The methodology employed is summarized below.

- The inventory of equipment for each area source and tank within the source is listed in Table 2-14. The inventory of equipment for the proposed tank and for tanks not in service (i.e., not currently part of the Subpart BB program) is assumed to be the same as an equivalent sized tank (see Note 1 of Table 2-14). For each equipment type, the number of leaks detected during the 2005 leak detection monitoring program is provided (DES, 2005). For any tank not monitored last year because the tank was not operational, and for the proposed tank, the number of leaks detected is assumed to be the same as that for a similar sized tank (see Note 1 of Table 2-14).

- Equipment emission factors are assigned for each type of equipment as per EPA guidance (EPA, 1995). It is conservatively assumed that all equipment is in light liquid service.

- The total VOC fugitive emission rate is calculated for each source area based on the number of leaks, the emission factors, and the fraction of VOC by waste type (11% for aqueous waste, 84% for organic waste). Total VOC emission rates are presented in Table 2-14.

- Speciated fugitive emissions from area sources were calculated for each organic COPC based on the COPC's concentration in aqueous and organic waste, as presented in Table 2-15.

3.0 Air Dispersion and Deposition Modeling

This section presents a description of the air dispersion and deposition modeling performed for the HHRA. Incinerator and associated fugitive emissions that can potentially effect human health are initially transported via the air pathway. The emissions occur as vapor and particulate phases. Air dispersion modeling is performed to estimate the distribution, concentration, and deposition rates of the emissions. The results are then used in the calculations for estimation of media concentrations, which are discussed in Section 5.

Section 3.1 provides a general overview of the air dispersion modeling approach. Section 3.2 summarizes the site specific characteristics considered in the air modeling. Section 3.3 discusses partitioning of emissions. Section 3.4 characterizes the meteorological data used in the air modeling. Section 3.5 discusses the air model input files. The output results of the air modeling are discussed in Section 3.6. Phase allocation and speciation for mercury modeling is discussed in Section 3.7.

3.1 Description of Air Dispersion Modeling

The objective of the air dispersion modeling is to provide unitized concentrations and deposition rates for the incinerator and fugitive emissions. Inputs to the air dispersion model include three main types of data: meteorological data, incinerator operating and fugitive emission characteristics, and receptor grid locations.

The EPA Industrial Source Complex - Short Term Version 3 (ISCST3) computer air dispersion model was used for air dispersion modeling as recommended in the HHRAP guidance document (EPA, 2005). A commercial software package with a graphical user interface, ISC-AERMOD View software (version 5.4) developed by Lakes Environmental Software (2005), was used to implement the ISCST3 computer code for the air dispersion modeling.

Air modeling requires the selection of geographic locations (receptor nodes) for emission estimates. A receptor grid array extending out to a distance of 10 km from the facility, which is illustrated in Figure 3-1, was designed for the air modeling effort. The grid was established on a cartesian coordinate system using Universal Transverse Mercator (UTM) coordinates based on the North American Datum established in 1927 (NAD 27). The center of the grid was located at the midpoint of a line connecting the facility incinerator stack and scrubber, at UTM coordinates

N 1986909, E 801476. The overall receptor grid is composed of three tiers with different node spacings. The inner tier consisted of nodes spaced 25 meters apart extending from the grid center out to 500 meters. The second tier consisted of nodes spaced 100 meters apart extending from the inner tier out to 3 km. The third tier consisted of nodes spaced 500 meters apart extending from the second tier out to 10 km. The UTM coordinates of each grid note were calculated by the ISC-AERMOD View air modeling software.

The ISC-AERMOD View model was run twice; once to model stack emissions including mercury, and a second run to model the scrubber and area sources. For all nodes the receptor grid, outputs from the model included annual average ambient air vapor and particulate concentrations, annual average vapor and particulate deposition rates, and hourly ambient air vapor and particulate concentrations.

3.2 Partitioning of Emissions

In accordance with HHRAP guidance, air dispersion modeled was performed for three possible emission partitions: vapor phase, particle phase, and particle-bound phase. High volatility organic COPCs occur only in the vapor phase. Most metals and organic COPCs with very low volatility occur only in the particle phase. The remaining organic COPCs occur as particle-bound, that is, with a portion of the vapor condensed to the surface of particulate. The ISCST3 model determines the partitioning into the various phases using the fraction of COPC in vapor phase physical characteristic for each COPC (see Table 5-1).

Modeling of the particle phase component utilizes the particle size distribution of the emissions and scavenging coefficients. Modeling of particle-bound phase utilizes the particle surface-area size distributions to apportion emissions. The particle size distribution and surface-area particle size distribution used for the air modeling are presented in Table 3-1. The distributions, which were also used in the January 2003 Preliminary Human Health Risk Assessment, were derived from data taken during a stack test in 1980. Table 3-1 also documents additional parameters, including scavenging coefficients, that were used in the air deposition modeling. The wet scavenging coefficients were verified with Jindal and Heinhold (1991) curves. The vapor wet scavenging coefficient was estimated using a 0.1 um particle size as per HHRAP guidance using Jindal and Heinhold curves.

3.3 Site-Specific Characteristics

Site-specific characteristics used in the air dispersion model include the elevation of the surrounding terrain, surrounding land use, and characteristics of on-site buildings. The on-site building characteristics were used for modeling and accounting for the effects of building downwash.

Individual terrain elevations were assigned for each grid node using U.S. Geological Survey (USGS) Digital Elevation Model (DEM) 7.5-minute files based on the NAD 27 datum and UTM coordinates. USGS DEM files consist of terrain elevations for ground positions at regularly spaced horizontal intervals. DEM files were imported into the ISC-AERMOD View software, which then assigned a terrain elevation for each grid node.

The surrounding land use was assumed to be rural for the air modeling due to the predominance of water and undeveloped land within the modeling area. Specific land use in the vicinity of the facility is discussed in Section 4.

Building characteristics used in the air model to account for building downwash effects are summarized in Table 3-2. Three buildings, the locations of which are shown in Figure 3-2, were identified with heights above 30 ft. Since the incinerator stack is 75 ft, any structures less than 30 ft (75/2.5 as per HHRAP guidance) would not have any downwash effect. The coordinates of the buildings were determined using NAD 27 UTM coordinate overlay maps. The building base elevations were determined using the NAD 27 DEM terrain elevations. The building heights were determined from on-site measurements. The ISC-AERMOD View software incorporates the Building Profile Input Program (BPIP) preprocessor program, which prepares the building characteristics for use in the air model.

Discussion and characterization of the watershed area used for the air dispersion model is presented in Section 4.

3.4 Meteorological Data

Meteorological data for the air dispersion modeling were the same as those used for the January 2003 Preliminary Human Health Risk Assessment. The meteorological data were supplied to AMAI in June 2006 by ERM Company, which performed the preliminary assessment.

Meteorological data for a full year record between April 18, 1994 and April 18, 1995 were used for the air modeling. The computer files provided by ERM worked directly with the ISC-AERMOD View software without the need for preprocessing.

ERM obtained the meteorological data from a measurement system installed a few meters south of the TAPI facility and also from various National Oceanic & Atmospheric Administration (NOAA) databases. The measurement system was installed by ENSR Corporation to collect wind speed, wind direction, and wind turbulence data in support of a Prevention of Significant Deterioration (PSD) application for the neighboring AES Puerto Rico Cogeneration Plant. ERM obtained processed data from the system from ENSR. The measurement system consisted of a tower instrumented at 10, 50, and 100 meter heights for measuring wind speed and direction and a doppler SODAR system. The SODAR system was used for measuring wind speed profiles and turbulence starting at 50 meters and increasing in 50 meter steps. Data capture rates were in excess of 99% for the tower data, and over 95% for the SODAR data. Figures 3-3 and 3-4 present wind roses of the wind speed and direction data at 10 meter and 50 meter heights, respectively, which were used for the air modeling.

A summary of data sources for the meteorological data used for the air modeling is as follows:

- Wind speed - From the AES tower at a height of 10 meters.
- Wind direction - From the AES tower at a height of 10 meters for fugitive emissions modeling (scrubber and area sources), and from a height of 50 meters for stack emissions modeling.
- Precipitation - From Hourly US Weather Observations provided by NOAA for San Juan, Puerto Rico. The data record used was for the same date period as for the AES data. The precipitation type was assumed to correspond to moderate rain.
- Mixing height - From the NOAA National Climatic Data Center for San Juan, Puerto Rico. San Juan is the closest location at which mixing height data were available. The data record used was for the same date period as for the AES data.
- Temperature - From AES tower at a 2 meter height.

- Wind stability category - Determined by ENSR using sigma-w measured at the AES tower 10 meter height.

- Surface roughness height - Calculated by ENSR from wind speed profiles measured at the tower and by the SODAR under neutral and moderate-to-high wind conditions. For wind directions from water and land, surface roughness heights of 3 cm and 15 cm, respectively, were used.

- Friction velocity - This boundary layer parameter was calculated by ENSR using meteorological data and a meteorological preprocessor (METPRO).

- Monin-Obukhov length - This boundary layer parameter was calculated by ENSR using meteorological data and a meteorological preprocessor (METPRO).

Several time periods were identified by ENSR in the meteorological data input files that had missing data. These data were filled in by interpolation if the time periods were less than or equal to two hours. For time periods greater than two hours, the data were filled in by substituting monthly/diurnal averages.

A single value for dry vapor deposition velocity of 0.5 cm/s for organics and of 2.9 cm/s for divalent mercury was used for the air modeling as recommended by the HHRAP guidance. Values in columns for the incoming short-wave radiation and leaf area index in the meteorological data file were set to a single dummy value, which was not used in any of the calculation, since single dry vapor deposition velocity values were used.

3.5 Air Model Input Files

The incinerator stack and scrubber were modeled as a point sources. Areas 1 through 4 were modeled as area sources for fugitive emissions. Figure 3-2 shows the locations of the various sources within the facility.

Operating parameters and characteristics for each source were selected to simulate actual operating conditions. Table 3-3 provides point and area source operating parameters and characteristics used for the air modeling. The air dispersion model was run assuming that all sources yield emissions simultaneously.

The ISC-AERMOD View software was run twice: once for the stack emissions, and once for the fugitive emissions for the area sources and scrubber. The ISC-AERMOD View software combines the calculation of unitized ambient air concentrations and deposition rates for the various emission phases into a single run of the model. The first run was performed to determine vapor phase ambient air concentrations, particulate ambient air concentrations, and deposition (wet and dry) rates from the incinerator stack emissions. Annual averages and one-hour ambient air concentrations were determined. This run included modeling for mercury, which is emitted from the stack. Modeling of mercury emissions is discussed further in Section 3.7.

The second run was performed to determine vapor phase concentrations and deposition (wet and dry) rates from the area sources and scrubber due to fugitive emissions. For this run, the Areas 1 through 4 were modeled as area sources and the scrubber was modeled as a point source. Annual averages and one-hour ambient air concentrations were determined. Modeling for the particulate phase was not performed since the emissions were all volatile. Modeling for mercury was also not performed for the second run since mercury is not emitted from the area sources or scrubber.

Table 3-4 provides a summary of the input control pathway parameters used for running the ISC-AERMOD View software. Detailed input control pathway files for the various modeling scenarios and pathways are included in Appendix D.

3.6 Air Model Output Files

The air dispersion model was run to estimate annual average concentrations and deposition rates for three phases: vapor phase, particle phase, and particle-bound phase. The model was also run to estimate one-hour ambient air concentrations. Annual average concentrations were for the estimation of media concentrations, which is discussed in Section 5. One-hour ambient air concentrations were used to evaluate acute inhalation hazard, which is discussed in Section 8.

The air dispersion model was run at an emission rate of 1.0 g/s for point sources and 1.0 g/s-m^2 for area sources in order to provide unitized output results.

The ISC-AERMOD View software created output files containing a verification of the model input, tables showing relative ambient air concentrations, and/or annual particle deposition rates at each receptor location. The output files are provided in Appendix E.

Figures 3-5 through 3-12 illustrate the annual average ambient air concentration and total deposition rate results for the vapor, particle, and particle-bound phase modeling for the incinerator stack. Figure 3-5 illustrates vapor phase ambient air concentrations from the stack, excluding mercury. Figure 3-6 illustrates vapor phase ambient air concentrations from the stack for mercury alone. Figures 3-7 and 3-8 illustrate particle and particle-bound ambient air concentrations, respectively, from the stack,. Figure 3-9 illustrates vapor phase total deposition rates from the stack, excluding mercury. Figure 3-10 illustrates vapor phase total deposition rates from the stack for mercury alone. Figures 3-11 and 3-12 illustrate particle and particle-bound total deposition rates, respectively, from the stack.

Figure 3-13 illustrates vapor phase ambient air concentrations for fugitive emissions from the scrubber. Figures 3-14, 3-15, 3-16, and 3-17 illustrate vapor phase ambient air concentrations for fugitive emissions from Area 1, Area 2, Area 3, and Area 4, respectively. Although not illustrated, dispersion patterns for total deposition from the scrubber and Areas 1 through 4 are similar to those for the vapor phase.

The figures show that the predominant air dispersion direction is to the west and southwest of the facility, which is expected based on the prevailing wind directions shown on the wind roses of Figure 3-3 and 3-4. Vapor phase ambient air concentrations from the stack tend to decrease with distance more rapidly than vapor phase deposition rates. In contrast, particle phase and particle bound phase deposition rates tend to decrease with distance more rapidly than corresponding ambient air concentrations. Within a distance of about 3 km southwest of the facility border, total ambient air concentrations and total deposition rates from the stack were reduced by factors of about 4 and 8, respectively. The areas of maximum concentration and deposition are somewhat limited in spatial extent. The receptor location that had the highest ambient air concentrations and deposition rates from all sources was located about 260 meters to the southwest of the emissions area.

The model outputs for the various sources and corresponding phases were subsequently summed across each receptor node and scaled using the emission rates discussed in Section 2. The scaling was performed using the Industrial Risk Assessment Program - Human Health software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006). Prior to use in IRAP-h View, the Air-2-Risk utility developed by Lakes Environmental Software was used to format the output results for use in the IRAP-h View software.

3.7 Modeling of Mercury

Mercury emissions were modeled by the ISC-AERMOD View software according to the HHRAP guidance. Emission of mercury, which occurs only for the incinerator stack, include both vapor and particulate forms. Most mercury is emitted in the vapor phase in the elemental and divalent form. A portion of mercury is also assumed to be emitted in the particulate phase composed primarily of the divalent form. Much of the divalent mercury is thought to be in the form of mercuric chloride. No emission of methyl mercury from the stack is assumed, although it is subsequently evaluated as a transformation product of deposited divalent mercury. The approach used for phase allocation and speciation of mercury, which was the protective approach recommended by HHRAP, is described below.

A phase allocation of 80 percent of total mercury in the vapor phase and 20 percent of total mercury in the particle-bound phase was assumed as per the HHRAP guidance. Of the 80 percent of total mercury in the vapor phase, 20 percent of the total was assumed to be in the elemental form and 60 percent of the total in the divalent form.

The majority of mercury exiting the stack does not readily deposit, but is vertically diffused to the free atmosphere and transported beyond the study area into the global mercury cycle. As per HHRAP guidance, over 99 percent of vapor-phase elemental mercury and is assumed to become part of the global cycle. About 32 percent of the divalent vapor phase mercury diffuses to the global cycle with about 68 percent depositing. About 64 percent of the divalent particle-bound phase mercury diffuses to the global cycle with about 36 percent depositing. Applying these percentages, 48.2 percent of total mercury is deposited, which is speciated as 40.8 percent divalent vapor, 7.2 percent divalent particle-bound, and 0.2 percent elemental vapor.

Of the total deposited mercury, 98 percent is assumed to remain divalent with 2 percent speciating to methyl mercury in soil as per HHRAP guidance. Of the total dissolved mercury in surface water for water body modeling, 85 percent is assumed to remain as divalent with 15% speciating to methyl mercury.

For calculating aboveground produce concentrations due to direct deposition, a speciation of 78 percent divalent mercury and 22 percent methyl mercury were used as per HHRAP guidance (Equation B-2-7).

4.0 Exposure Scenario Identification

This section provides a characterization of the exposure setting and information on selected exposure scenarios and exposure scenario locations.

4.1 Characterization of Exposure Setting

The purpose of characterizing the exposure setting is to identify the human receptors, their land uses and activities, that might be impacted by exposure to emissions form the facility.

4.1.1 Current Land Use

Land use within a 3-km radius of the TAPI facility is primarily a mix of industrial and residential with some evidence of limited agricultural use. A substantial amount of land within 3 km of the facility is undeveloped. The Caribbean Sea occurs at 2 km south of the facility. Further detail is presented below. Figure 4-1 shows land use within 3 km of the facility. A zoning map for the vicinity of the TAPI facility is presented in Figure 4-2.

- Immediately north of the TAPI facility is undeveloped land. This land is zoned for residential use. Approximately 2 km north of the facility is a prison and a manufacturing facility. Industrial facilities are located approximately 1.5 km to the northeast of the facility. The village of Jobos (population 6,993 based on 1990 census) is located approximately 1.5 km to the northwest of the facility. Beyond the village of Jobos is undeveloped land reportedly used in the past for sugar cane growing. Some cattle grazing is now observed in this area.

- Immediately to the west of the TAPI facility is undeveloped land which is zoned for residential use. West of this undeveloped land is a mangrove area which extends to Bahia de Jobos, located approximately 2 km west of the facility. There are a number of residences sparsely distributed to the south of this mangrove area.

- A coal fired power plant is located adjacent to the TAPI facility to the south. Beyond the power plant is the Caribbean Sea which is located approximately 2 km south of the TAPI facility.

- A petroleum refining facility and associated tank farm is located immediately east of the TAPI facility. Beyond this facility is undeveloped land which is zoned for residential use. The small village of Barrancas is located approximately 2.5 km east of the TAPI facility.

Land use between 3 km and 10 km of the TAPI facility is generally residential or undeveloped as shown in Figure 4-3 and as described below:

- To the north and northwest, undeveloped land extends to the foothills of the Cordillera Central mountains which occur approximately 7 km north of the facility. Limited cattle grazing has been observed in these areas.

- Bahia de Jobos extends to the west and southwest of the facility to approximately 10 km. The village of Puerto de Jobos is located approximately 3.5 km west of the TAPI facility. The residential areas of Aguirre, Central Aguirre, and San Falipe are located between 7 and 9 km west of the facility. Otherwise, land in this area is generally undeveloped.

- The Caribbean Sea is located approximately 4 km due east of the TAPI facility. Approximately 5 km to the northeast is the Town of Guayama (population 41,650 based on 1990 census). Mountains occur approximately 9 km northeast of the site. Otherwise, land in this area is generally undeveloped.

Land use to the west of the TAPI facility to a distance of 50 km is generally undeveloped or residential/commercial. Mountains exist to the north to a distance beyond 50 km. The mountains are sparsely populated. To the east of the TAPI facility, land use is generally residential/commercial or is undeveloped. No current or potential future land use conditions have been identified beyond 10 km that would justify additional exposure scenarios.

4.1.2 Potential Future Land Use

Land within 3 km of the TAPI facility which has been developed for residential or industrial use will likely remain is such use. Since the undeveloped land to the north, east, and west of the TAPI facility is zoned for residential use, it is assumed that future land use in these areas will be residential. For the purposes of this risk assessment, it is assumed that the undeveloped land to the northwest of the village of Jobos will be used for agricultural purposes, including cattle grazing. Such usage is consistent with reported historical use and reasonable considering cattle grazing is observed in the area.

For areas between 3 and 10 km form the site, it is also assumed that current land use (primarily residential) will remain so. Undeveloped areas will either be used for residential use or for agricultural purposes.

4.1.3 Water Bodies and Associated Watersheds

The predominant water body within a 3 km radius of the TAPI facility, besides the Caribbean Sea, is the Bahia de Jobos, which is an inlet of the Caribbean Sea. Bahia de Jobos, shown in Figure 4-4, is a tidal water body that extends at its nearest point from approximately 2 km west of the TAPI facility to about 10 km west of the facility. The surface area of the bay is approximately 4,000 acres. The average depth of the bay is about 12 ft.

The Bahia de Jobos watershed is also shown in Figure 4-4. The two major tributaries to the Bahia de Jobos are Rio Seco and Quebrada Melania. The watersheds for these streams are contained within the Bahia de Jobos watershed. It is assumed that runoff from the Bahia de Jobos watershed will flow into the bay. Due to its location generally downwind of the TAPI facility, Bahia de Jobos and its watershed receive deposition from the TAPI incinerator. Therefore, deposition of COPCs falling within the Bahia de Jobos watershed will impact the quality of the surface water within Bahia de Jobos.

It is assumed for the purposes of this risk assessment that Bahia de Jobos sustains a fish population that is harvested by humans. Therefore, the fisher scenario will be included in the risk assessment as described in Section 4.2.

As described in Section 2.1, other small streams and tidal creeks exist in the area surrounding the TAPI facility. However, due to the limited flow, it is unlikely that significant amounts of fish are harvested from these streams.

Water supply for residents in the vicinity of the TAPI facility is provided by the Puerto Rico Aqueduct and Sewer Authority (PRASA). Water provided by PRASA comes from groundwater from the deep coastal aquifers and from surface water bodies located in the mountains well north of the TAPI facility. Figure 4-2 shows that there are no significant water bodies within 10 km of the TAPI facility. Surface water bodies that appear on the map are generally associated with previously operated irrigation systems serving the sugar cane plantations. Since there are no surface water bodies that serve as drinking water sources for residents that would reasonably be

expected to be impacted by facility emissions, the drinking water pathway is excluded from consideration in this risk assessment.

4.1.4 Special Population Characteristics

Three schools are located within the village of Jobos which is the closest residential area to the TAPI facility and the residential area most impacted by facility emissions based on prevailing wind direction. Therefore, any risk to children attending school in Jobos would be greater than risk to children attending any other school in the area of the TAPI facility. Potential risks to school children will be assessed as discussed in Section 4.2.3. No other special receptors, such as day care centers, nursing homes or hospitals, were identified at locations that may pose an unacceptable to inhabitants due to emissions from the TAPI facility.

4.2 Selected Exposure Scenarios

An exposure scenario is defined as a combination of exposure pathways to which receptor is subjected at a particular location. Table 4-1 presents the exposure scenarios and the exposure pathways for each scenario selected for evaluation in this HHRA. Exposure scenarios are listed below and are described in detail in the following sections.

- Farmer
- Farmer Child
- Resident
- Resident Child
- Fisher
- Fisher Child
- Acute Receptor

4.2.1 Farmer

The farmer exposure scenario is made up of the exposure pathways through which an adult member of a farmer or ranching family could be exposed. The farmer scenario is being evaluated as part of this HHRA due to the availability of undeveloped land in the vicinity of TAPI that may currently be used, or may be used in the future, for farming.

While on the farm property, a farmer may inhale air containing COPC-impacted vapors and suspended particles and, through daily activities, may ingest incidental amounts of soil. It is assumed that the farm family raises and consumes beef and milk cattle, pigs and free-range chickens, including eggs. Cattle will ingest soil while foraging on a grazing field, as well as being fed silage and grain grown on the farm. Pigs are contained within a yard or small field where they are assumed not to forage, but ingest soil while being fed a combination of silage and grain grown on the farm. Free-range chickens are contained within a yard or field where they ingest soil while being fed grain grown on the farm. It is assumed that the farmer grows enough fruits and vegetables to supply the family with produce.

Based on the foregoing, it is assumed that the farmer will be exposed to COPCs emitted from the facility through the following exposure pathways:

- Direct inhalation of vapors and particles
- Incidental ingestion of soil
- Ingestion of homegrown produce (i.e., fruits and vegetables)
- Ingestion of beef
- Ingestion of milk from homegrown cows
- Ingestion of homegrown chicken
- Ingestion of eggs from homegrown chicken
- Ingestion of homegrown pork
- Ingestion of breast milk (evaluated separately for an infant of the farmer)

4.2.2 Farmer Child

The farmer child exposure scenario is made up of the exposure pathways through which a child member of a farming or ranching family may reasonable be expected to be exposed. It is assumed that the farmer child is exposed to COPCs emitted from the TAPI facility through the same exposure pathways as the farmer. The primary differences between the farmer and the farmer child are in exposure duration and consumption rates, as discussed in Section 6.

4.2.3 Resident

The resident exposure scenario is made up of the exposure pathways through which an adult receptor may be exposed in an urban or nonfarm rural setting. The resident exposure scenario is being evaluated as part of this HHRA due to the residential land use, and potential future residential use of undeveloped land, in close proximity to the TAPI facility.

While on their property, a resident may inhale air containing COPC-impacted vapors and suspended particles and, through daily activities, may ingest incidental amounts of soil. It is assumed that the resident grows fruit and vegetables for home consumption.

The resident exposure scenario will also be used to assess risks to children attending school in Jobos. This is a conservative assumption which will overestimate risks to children but is intended to demonstrate that no unacceptable risks are posed to children here or at any other school in the TAPI area.

Based on the foregoing, it is assumed that the resident will be exposed to COPCs emitted from the facility through the following exposure pathways:

- Direct inhalation of vapors and particles
- Incidental ingestion of soil
- Ingestion of homegrown produce (i.e., fruits and vegetables)
- Ingestion of breast milk (evaluated separately for an infant of the resident)

4.2.4 Resident Child

The resident child exposure scenario is made up of the exposure pathways through which a child receptor may be exposed in an urban or nonfarm rural setting. It is assumed that the resident child is exposed to COPCs emitted from the TAPI facility through the same exposure pathways as the resident adult. The primary differences between the resident and the resident child are in exposure duration and consumption rates, as discussed in Section 6.

4.2.5 Fisher

The fisher exposure scenario is made up of the exposure pathways through which an adult receptor may be exposed in an urban or nonfarm rural setting where fish is the main source of protein in the receptor diet. The fisher exposure scenario is being evaluated as part of this HHRA due to the proximity of a viable fishery (Bahia de Jobos) to the TAPI facility.

While on the their property, the fisher may inhale air containing COPC-impacted vapors and suspended particles and, through daily activities, may ingest incidental amounts of soil. It is assumed that the fisher grows fruit and vegetables for home consumption and harvests enough fish from water bodies in the study area impacted by facility emissions to supply the family with a significant portion of their protein.

Based on the foregoing, it is assumed that the fisher will be exposed to COPCs emitted from the facility through the following exposure pathways:

- Direct inhalation of vapors and particles
- Incidental ingestion of soil
- Ingestion of homegrown produce (i.e., fruits and vegetables)
- Ingestion of fish
- Ingestion of breast milk (evaluated separately for an infant of the fisher)

4.2.6 Fisher Child

The fisher child exposure scenario is made up of the exposure pathways through which a child receptor may be exposed in an urban or nonfarm rural setting where fish is the main source of protein in the receptor diet. It is assumed that the fisher child is exposed to COPCs emitted from the TAPI facility through the same exposure pathways as the fisher adult. The primary differences between the resident and the resident child are in exposure duration and consumption rates, as discussed in Section 6.

4.2.7 Acute Receptor

In addition to the long term chronic effects evaluated in the exposure scenarios described above, acute exposure scenarios are evaluated in this HHRA. The acute receptor scenario accounts for

short term effects of exposure to maximum 1-hour concentrations of COPCs in emissions from the TAPI facility through direct inhalation of vapors and particles.

4.3 Selection of Exposure Scenario Locations

Exposure scenario locations are the physical places within the study area selected for each of the exposure scenarios being evaluated. Exposure scenario locations have been selected based on reasonable, worst case assumptions considering current and future land use patterns and on COPC air concentrations and deposition rates specific to land use areas. For the purposes of this risk assessment, exposure scenario locations are assumed to be the same for both current and future land use.

The methodology employed to select exposure scenario locations is summarized below:

- The land use areas to be evaluated were defined for the resident and farmer exposure scenarios. It is assumed that the fisher and fisher child reside at the same exposure scenario location as the resident scenario. These land use areas were mapped using UTM coordinates to ensure consistency with locations of facility emission sources and air dispersion model receptor grid nodes (see Figure 4-5). The rationale for land use area definition for each exposure scenario is discussed below:

  - Resident and Fisher - The resident land use area was defined based on current land use patterns (i.e., existing residential land use) and reasonable potential future land use patterns based on current zoning. It is assumed that all areas zoned as residential will ultimately be developed for residential land use.

  - Farmer - The farmer land use area was defined based on current land use patterns and reasonable potential future land use patterns. An area to the northwest of the village of Jobos has been designated as the exposure location for the farmer as shown in Figure 4-5. This is appropriate due to the prior use of the area for agricultural purposes (i.e., sugar cane), the availability of land nearer to the town for residential development, and the cattle grazing that has been observed in the area. Due to its location generally downwind of the TAPI emission sources, this is the area with reasonable potential for future agricultural use that is most heavily impacted by facility emissions.

- For each defined land use area, the receptor grid nodes within or on the boundary of that area that represent the highest yearly average concentration of each dispersion model output (i.e., air concentration, dry deposition, wet deposition) for each phase (i.e., vapor, particle, particle-bound) were identified. This resulted in identifying receptor grid nodes with the following attributes:

  - Highest vapor phase concentration
  - Highest vapor phase dry deposition rate
  - Highest vapor phase wet deposition rate
  - Highest particle phase air concentration
  - Highest particle phase wet deposition rate
  - Highest particle phase dry deposition rate
  - Highest particle-bound phase air concentration
  - Highest particle-bound phase wet deposition rate
  - Highest particle-bound phase dry deposition rate

- For acute risk, the receptor grid nodes within or on the boundary of each defined land use area that represent the highest hourly average vapor phase air concentration and the highest hourly particle phase air concentration were identified.

- For the fisher exposure scenario, the average of each dispersion model output (i.e., air concentration, dry deposition, wet deposition) for each phase (i.e., vapor, particle, particle-bound) for all receptor grid nodes within the area of the water body (i.e., Bahia de Jobos) and its drainage area were identified.

5.0 Estimation of Media Concentrations

This section presents the equations and associated parameters for estimating media concentrations of COPCs used to evaluate the exposure scenarios discussed in Chapter 4. COPC concentrations were calculated for the following media:

- Air
- Soil
- Produce
- Beef and dairy products
- Pork
- Chicken and eggs
- Fish

All equations used to calculate exposure media concentrations are identified in the following sections. Each equation identified below is presented in Appendix F, which contains an electronic copy of Appendix B of HHRAP ("Estimating Media Concentrations and Variable Values"). The location of the referenced equation within the Appendix is provided after each equation identified below (i.e., table number).

Values for the variables used in the equations are presented in Tables 5-1 through 5-3, as follows:

- Table 5-1: COPC-specific variables
- Table 5-2: Site -specific variables for which HHRAP default values are used
- Table 5-3: Site-specific variables for which HHRAP default values are not used. The basis for each value is presented in the table.

Media concentration calculations were performed with the Industrial Risk Assessment Program - Human Health software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006), which estimates COPC media concentrations, intakes, risk, and hazard in accordance with the HHRAP guidance.

Estimated media concentrations as calculated using the equations described below are used in quantifying the exposure received under each of the exposure scenarios being evaluated in this risk assessment.

5.1 COPC Concentrations in Air for Direct Inhalation

COPC concentrations in air were calculated by summing the vapor phase and particle phase air concentrations of COPCs. For chronic exposure via direct inhalation, unitized yearly air parameter values determined by air dispersion modeling were used to calculate air concentrations. For acute exposure via direct inhalation, unitized hourly air parameter values determined by air dispersion modeling were used to calculate air concentrations.

Equations used in calculating media concentrations and their locations in Appendix F are identified below:

- Air Concentration - Table B-5-1
- Acute Air Concentration - Table B-6-1

5.2 COPC Concentrations in Soil

COPC concentrations in soil were calculated by summing the vapor phase and particle phase deposition of COPCs to the soil. Wet and dry deposition of vapor and particles were considered. Soil concentrations were adjusted to account for loss of COPCs by several mechanisms, including leaching, runoff, degradation (biotic and abiotic), and volatilization. Since contaminated soil may erode both onto and off of any location, the COPC loss due to soil erosion is assumed to be zero.

Equations used in calculating COPC concentrations in soil and their locations in Appendix F are identified below:

- Soil Concentration Due to Deposition - Table B-1-1
- COPC Soil Loss Constant - Table B-1-2
- COPC Soil Loss Constant Due to Soil Erosion - Table B-1-3
- COPC Soil Loss Constant Due to Soil Runoff - Table B-1-4
- COPC Soil Loss Constant Due to Soil Leaching - Table B-1-5
- COPC Soil Loss Constant Due to Soil Volatilization - Table B-1-6

5.3 COPC Concentrations in Produce

Indirect exposure resulting from ingestion of produce depends on the total concentration of COPCs in the leafy, fruit, and tuber portions of the plant. For the purposes of this risk assessment, produce is divide into three general categories: aboveground exposed produce, aboveground protected produce, and belowground produce. Aboveground exposed produce is assumed to be contaminated by three mechanisms: direct deposition of particles, vapor transfer, and root uptake. Total COPC concentration in aboveground exposed produce is calculated as the sum of contamination occurring through all three of these mechanisms. Aboveground protected produce and belowground produce is assumed to be contaminated only by root uptake.

Equations used in calculating COPC concentrations in produce and their locations in Appendix F are identified below:

- COPC Concentrations in Soil equations identified in Section 5.1
- Aboveground Produce Concentration due to Direct Deposition - Table B-2-7
- Aboveground Produce Concentration due to Air-to-Plant Transfer - Table B-2-8
- Aboveground Produce Concentration due to Root Uptake - Table B-2-9
- Belowground Produce Concentration due to Root Uptake - Table B-2-10

5.4 COPC Concentrations in Beef and Dairy Products

COPC concentrations in beef tissue and milk products are estimated on the basis of the amount of COPCs that cattle are assumed to consume in their diet. It is assumed the cattle's diet consists of forage (primarily pasture grass and hay), silage (forage that has been stored and fermented), and grain. Additional contamination may occur through the cattle ingesting soil. The total COPC concentrations in feed items is calculated as the sum of direct deposition of particles, vapor transfer, and root uptake.

Feed items consumed by cattle are classified as exposed or, if they have an outer covering, protected. For protected feed, including grain, it is assumed that contamination occurs only through root uptake. Contamination of exposed items, including forage and silage, occurs through all three mechanisms identified above. It is assumed that 100% of the plant material eaten by cattle were grown on soil contaminated by emission sources. Also, it is assumed that the amount of grain, forage, silage, and soil consumed varies between dairy and beef cattle.

Equations used in calculating COPC concentrations in beef and dairy products and their locations in Appendix F are identified below:

- COPC Concentrations in Soil equations identified in Section 5.1
- Forage and Silage Concentrations due to Direct Deposition - Table B-3-7
- Forage and Silage Concentrations due to Air-to-Plant Transfer - Table B-3-8
- Forage/Silage/Grain Concentrations due to Root Uptake - Table B-3-9
- Beef Concentration due to Plant and Soil Ingestion - Table B-3-10
- Milk Concentration due to Plant and Soil Ingestion - Table B-3-11

5.5 COPC Concentrations in Pork

COPC concentrations in pork are estimated on the basis of the amount of COPCs that swine are assumed to consume in their diet. It is assumed the swine's diet consists of silage and grain. Because swine are not grazing animals, they are assumed not to eat forage. Additional contamination of pork tissue may occur through the ingestion of soil.

Equations used in calculating COPC concentrations in pork and their locations in Appendix F are identified below:

- COPC Concentrations in Soil equations identified in Section 5.1
- Pork Concentrations due to Plant and Soil Ingestion - Table B-3-12

5.6 COPC Concentrations in Chicken and Eggs

COPC concentrations in chicken and eggs are estimated on the basis of the amount of COPCs that chicken are assumed to consume in their diet. It is assumed the chicken's diet consists 90% of grain grown at the exposure location. It is therefore assumed that 100% of the grain consumed is contaminated. It is also assumed that chickens consume 10% of their diet as soil. Because chickens are not grazing animals, they are assumed not to eat forage. They are also assumed not to eat silage.

Equations used in calculating COPC concentrations in chicken and eggs and their locations in Appendix F are identified below:

- COPC Concentrations in Soil equations identified in Section 5.1
- COPC Concentration in Eggs - Table B-3-13
- COPC Concentration in Chicken - Table B-3-14

5.7 COPC Concentrations in Surface Water and Fish

COPC concentrations have been estimated for surface water and fish in Bahia de Jobos which, as described in Section 4, is the water body being quantitatively evaluated in this risk assessment as a potential fish ingestion exposure pathway. The drinking water exposure pathway has been excluded from this risk assessment due to the absence of surface water bodies in the vicinity of the TAPI facility that serve or may in the future serve as drinking water sources and that may be impacted by facility emissions.

Mechanisms considered in determining COPC loading of surface water in Bahia de Jobos include the following:

- Direct deposition
- Runoff from impervious surfaces within the Bahia de Jobos watershed
- Runoff from pervious surfaces in the watershed
- Soil erosion over the watershed
- Direct diffusion of vapor phase COPCs into the surface water
- Internal transformation of COPCs chemically or biologically

It is assumed that the total concentration of each COPC partitions between the sediment and the water column.

Equations used in calculating COPC concentrations in surface water and sediment and their locations in Appendix F are identified below:

- COPC Concentrations in Soil equations identified in Section 5.1
- Forage and Silage Concentrations due to Direct Deposition - Table B-3-7
- Total Water Body Load - Table B-4-7
- Deposition to Water Body - Table B-4-8
- Impervious Runoff Load to Water Body - Table B-4-9
- Pervious Runoff Load to Water Body - Table B-4-10
- Erosion Load to Water Body - Table B-4-11

- Diffusion Load to Water Body - Table B-4-12
- Universal Soil Loss Equation - Table B-4-13
- Sediment Delivery Ratio - Table B-4-14
- Total Water Body Concentration - Table B-4-15
- Fraction in Water Column and Benthic Sediment - Table B-4-16
- Overall Water Body Dissipation Rate Constant - Table B-4-17
- Water Column Volatilization Loss Rate Constant - Table B-4-18
- Overall COPC Transfer Rate Coefficient - Table B-4-19
- Liquid Phase Transfer Coefficient - Table B-4-20
- Gas Phase Transfer Coefficient - Table B-4-21
- Benthic Burial Rate Constant - Table B-4-22
- Total Water Column Concentration - Table B-4-23
- Dissolved Phase Water Concentration - Table B-4-24
- COPC Concentration Sorbed to Bed Sediment - Table B-4-25

COPC concentrations in fish were estimated using COPC-specific bioaccumulation factors and biota-sediment accumulation factors. COPC concentrations in fish are calculated using dissolved water concentrations and benthic sediment concentrations. Equations used in calculating COPC concentrations in fish and their locations in Appendix F are identified below:

- Fish Concentration From Bioaccumulation Factors Using Dissolved Phase Water Concentration - Table B-4-27
- Fish Concentration From Bio-to-Sediment Accumulation Factors Using COPC Sorbed to Bed Sediment - Table B-4-28

6.0 Quantifying Exposure

This section describes the methodology used to calculate intake rates of COPCs under each of the exposure scenarios discussed in Section 4. Section 6.1 describes exposure assumptions used in quantifying exposure rates. Section 6.2 describes the equations used in quantifying COPC-specific exposure rates under each exposure scenario.

Intake rate calculations were performed with the Industrial Risk Assessment Program - Human Health software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006), which estimates COPC media concentrations, intakes, risk, and hazard in accordance with the HHRAP guidance.

6.1 Exposure Assumptions

Exposure assumptions used in the COPC intake equations discussed below in Section 6.2 are presented in Table 6-1. All values are consistent with default values presented in HHRAP. The exposure assumptions are used the risk characterization presented in Section 8.

6.2 Calculation of COPC Intake Rates

COPC-specific exposure rates were calculated for each exposure pathway included in an exposure scenario, as discussed in Section 4 and summarized in Table 4-1. Exposure rates were calculated based on media concentrations developed in Section 5 and on exposure assumptions discussed in Section 6.1 as per HHRAP guidance.

Equations used to calculate COPC-specific indirect exposure rates are identified below. Each equation is presented in Appendix G, which contains an electronic copy of Appendix C of HHRAP ("Risk Characterization Equations"). The location of the referenced equation within the Appendix is provided after each equation identified below (i.e., table number).

- COPC Intake from Soil - Table C-1-1. This equation is used to calculate the daily intake of COPCs from soil ingestion. Soil concentrations vary with each scenario location and the soil ingestion rate varies for children and adults. For carcinogenic COPCs, the soil concentration is averaged over the exposure duration. For noncarcinogenic COPCs, the highest annual soil concentration occurring within the exposure duration is used.

- COPC Intake from Produce - Table C-1-2. This equation is used to calculate the daily intake of COPCs from ingestion of exposed aboveground, protected aboveground, and belowground produce. COPC concentrations in produce vary with each scenario location. The consumption rate varies for children and adults and for types of produce. For carcinogenic COPCs, the soil concentration used in the equation is averaged over the exposure duration. For noncarcinogenic COPCs, the highest annual soil concentration occurring within the exposure duration is used.

- COPC Intake from Beef, Milk, Pork, Poultry, and Eggs - Table C-1-3. This equation is used to calculate the daily intake of COPCs from ingestion of animal products. COPC concentrations in animal products vary with each scenario location. The consumption rate varies for children and adults and for the type of animal product. For carcinogenic COPCs, the soil concentration used in the equation is averaged over the exposure duration. For noncarcinogenic COPCs, the highest annual soil concentration occurring within the exposure duration is used.

- COPC Intake from Fish - Table C-1-4. This equation is used to calculate the daily intake of COPCs from ingestion of fish. The consumption rate varies for children and adults.

- Total Daily Intake - Table C-1-6. This equation is used to calculate the daily intake of COPCs from all indirect exposure pathways.

COPC-specific exposure rates calculated using the equations identified above are used in the risk characterization presented in Section 8.

Calculation of COPC-specific direct exposure rates via inhalation are incorporated into the inhalation cancer risk, inhalation hazard quotient, and breast milk equations identified below. These equations are discussed further in Section 8.

- Inhalation Cancer Risk for Individual Chemicals - Table C-2-1
- Inhalation Hazard Quotient for COPCs - Table C-2-2
- Concentrations of dioxin and dioxin-like PCBs in breast milk - Table C-3-1

7.0 Toxicity Characterization

In this toxicity characterization section, information is provided to quantify the health effects associated with human exposure to COPCs. The purpose of the toxicity characterization is to gather and weigh available evidence regarding potential adverse health effects from human exposure. Risk is a function of the toxicity of a compound, the exposure dose, and the length of exposure.

Both carcinogenic and non-carcinogenic information is provided. Only some of the constituents have the potential to produce carcinogenic effects, while the majority of constituents have the capacity to produce non-carcinogenic effects if the exposure concentration and duration is sufficiently great. For those constituents which may cause both non-carcinogenic and carcinogenic effects, both effects on human health are evaluated.

7.1 Noncarcinogenic Factors

It is generally believed that noncarcinogenic chemicals have a threshold concentration below which there is no adverse health effect. The concentration must be sufficiently great such that protective mechanisms in the body are overcome before an adverse health effect occurs. The measure of the potential noncarcinogenic toxic effects of a constituent are presented in terms of a reference dose (RfD) for ingestion and a reference concentration (RfC) for inhalation. The RfDs and RfCs are estimates of daily exposure to a chemical that can likely occur without an appreciable risk of deleterious effects over a human lifetime (EPA, 1990). RfCs represent air concentrations (in mg/m^3) at which adverse or deleterious effects are unlikely. Inhalation RfCs are used to estimate the hazards associated with inhalation and particulate emissions. Table 7-1 presents RfDs and RfCs for the contaminants of concern evaluated in this risk assessment.

The reference dose is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk or deleterious effects during a lifetime" (EPA, 1990). The RfD is calculated by obtaining the No Observed Adverse Effect Level (NOAEL) for the most sensitive sex of the most sensitive species. The NOAEL is divided by uncertainty factors and modifying factors. Uncertainty factors of 10 are used to extrapolate between animals and

humans, to account for especially sensitive individuals, to expand from a subchronic to a chronic dose, to estimate the NOAEL when the Lowest Observed Adverse Effect (LOAEL) was used and to consider other deficiencies. The modifying factor is ≥ 0 and ≤ 10 and used to account for scientific deficiencies in the database (EPA, 1989, 1990). The confidence in the RfDs are based on the underlying database of information. A RfD based on several studies with consistent information will have a higher confidence level than a RfD based on just one study (EPA, 1990).

7.2 Carcinogenic Factors

It is generally assumed that there is no threshold concentration below which cancer will not occur. Consequently, EPA assumes that a carcinogenic compound may result in a response no matter how small the dose. The measure of the carcinogenic potency of a carcinogenic constituent is presented in terms of a slope factor (SF). Slope factors are usually determined in the laboratory by linear extrapolation from animal experiments using high exposure doses. Human exposure limits are computed by extrapolating from the animal experiments to lower human exposure doses. There are uncertainties inherent in published slope factors including extrapolation from animal species to humans and from high laboratory exposure doses to low environmental doses.

Table 7-1 presents slope factors and unit risk factors for the carcinogenic constituents of concern evaluated in this risk assessment. Unit risk factors for air inhalation were converted to cancer slope factors. Slope factors were preferable to unit risk factors as they allowed for assessment of air inhalation risk.

7.3 Sources of Dose Response Values

The dose response values for carcinogenic and noncarcinogenic effects used in this risk assessment were obtained from the HHRAP database (EPA, 2005), except for propionaldehyde. The dose response values for propionaldehyde were obtained from Texas Natural Resource Conservation Commission (TNRCC, 2004).

The HHRAP database values were checked against the Integrated Risk Information System (IRIS), HEAST, and other published toxicity databases to ensure that they are the most current values. Minor differences in the noncarcinogenic oral RfDs and RfCs were noted for toluene, barium, and/or cadmium. The RfDs for barium and cadmium and the RfC for toluene increased

meaning that calculated hazards are conservative. The oral RfD for toluene decreased by 60% from 0.2 to 0.08 mg/kg-day. This decrease has an insignificant effect on total hazards to human health based on the risk characterization presented in Section 8.

7.4 Additive Effects

Health effects associated with human exposure discussed in this risk assessment are assumed to be additive. Risks associated with individual constituents are added to arrive at a total pathway specific exposure risk. Though information about synergistic and antagonistic effects from multiple exposures does exist in the literature, not enough is currently known to justify the inclusion of synergistic or antagonistic effects of exposure from multiple toxic chemicals in this risk assessment. Therefore, the assumption of additive effects from multiple toxic chemicals is uncertain.

7.5 Acute Inhalation Factors

In addition to long term chronic effects, this HHRA considers short term acute hazards from direct inhalation of vapor phase and particle phase COPCs. Acute inhalation exposure criteria (AIEC) used in calculating acute hazards were obtained from the HHRAP database (EPA, 2005). AIECs are presented in Table 7-1. The method used for estimating acute inhalation hazards is discussed in Section 8.4.

8.0 Characterizing Risk and Hazard

This section provides a characterization of the risks and hazards (risk characterization) for the HHRA. The objective of the risk characterization is to develop estimates of the excess lifetime cancer risk (risk) and noncancer hazard (hazard) for each exposure pathway and receptor. Risks and hazards were estimated using measured emission rates presented in Section 2 from the March-April 2006 Comprehensive Performance Test of the two facility Trane hazardous waste incinerators. Air dispersion modeling discussed in Section 3 was performed using the emission rate data to determine ambient air concentrations and deposition rates. Exposure scenarios were identified in Section 4. Media concentrations were estimated using the air dispersion modeling results for the various exposure scenarios as discussed in Section 5. Exposure assumptions and calculation of COPC intake rates for the various exposure pathways and receptors are discussed in Section 6. Toxicity benchmarks are discussed in Section 7.

In this section (Section 8), risk and hazard estimates are calculated by integrating the intake rates developed in Section 6 and toxicity benchmarks presented in Section 7. Risks and hazards for all applicable pathways for each receptor were then summed to obtain an estimate of total individual risk and hazard. An evaluation of noncancer hazards from PCDDs/PCDFs and coplanar PCBs, lead exposures from soil, and acute hazards from direct inhalation is also provided in this section.

Section 8.1 presents the method for calculating cancer risk. Section 8.2 presents the method for calculating noncancer hazards. Section 8.3 discusses the method for evaluation of the breast milk pathway. Section 8.4 discusses the method for evaluating acute inhalation exposure. Section 8.5 describes the target levels. Section 8.6 presents the risk description. Lastly, Section 8.7 discusses documentation of the risk and hazard calculations. An uncertainty analysis, which is part of the risk characterization, is presented in Section 9.

Risk calculations were performed using the Industrial Risk Assessment Program - Human Health software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006), which estimates COPC media concentrations, intakes, risk, and hazard in accordance with the HHRAP guidance (EPA, 2005a). Lakes Environmental Software reports that the software has been validated by EPA Regions 4 and 6.

8.1 Quantitative Estimation of Cancer Risk

Cancer risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of specific exposure to a carcinogenic chemical (EPA, 2005a). Equations for estimating cancer risk, which are as per the HHRAP guidance, are discussed below and provided in tables presented in Appendix G. Cancer toxicity values used in the equations are discussed in Section 7.

Inhalation cancer risk for individual COPCs was estimated using the equation described in Table C-2-1. Total inhalation cancer risk for each source was estimated using the equation described in Table C-2-3. Variables for the equations are presented in Table 6-1.

Cancer risk through indirect exposure to individual COPCs via soil, produce, animal products, and fish, was estimated using the equation described in Table C-1-7. Total indirect cancer risk for each source was estimated using the equation described in Table C-1-9. Variables for the equations are presented in Table 6-1.

Total cancer risk summed across all sources and exposure pathways (inhalation and indirect) was estimated using the equation and variables described in Table C-1-9. Cancer risk results are discussed in Section 8.6.

8.2 Quantitative Estimation of Noncancer Hazard

A noncancer hazard is the potential for developing noncancer health effects as a result of exposure to noncarcinogenic COPCs. Noncancer risk for individual chemicals is estimated by means of a hazard quotient (HQ). The total noncancer hazard attributable to all COPCs through a single exposure pathway is known as a hazard index (HI). The cumulative HI is estimated by summing HIs across all pathways. Equations for estimating noncancer hazard, which are as per the HHRAP guidance, are discussed below and provided in tables presented in Appendix G. Noncancer toxicity values used in the equations are discussed in Section 7.

Inhalation noncancer HQs for individual COPCs was estimated using the equation described in Table C-2-2. The hazard index for inhalation exposure for each source was estimated using the equation described in Table C-2-4. Variables for the equations are presented in Table 6-1.

Noncancer HQs for indirect exposure to individual COPCs via soil, produce, animal products, and fish, was estimated using the equation described in Table C-1-8. The indirect noncancer hazard index for each source was estimated using the equation described in Table C-1-10. Variables for the equations are presented in Table 6-1.

The cumulative noncancer hazard summed across all sources and exposure pathways (inhalation and indirect) was estimated using the equation and variables described in Table C-1-10. Noncancer hazard results are discussed in Section 8.6.

8.3 Method for Estimating Infant Exposure to Breast Milk

The breast milk pathway is evaluated to assess the potential risk to nursing infants exposed to dioxins (PCDDs and PCDFs) and dioxin-like coplanar PCBs ("dioxins"). This pathway is evaluated because of concern about the potential for infants to be exposed to these substances and their sensitivity to them as per HHRAP guidance. Exposure to dioxins is of concern because these substances readily accumulate in lipids and have been detected in breast milk. Infants are of particular concern because, on a body weight basis, they are potentially exposed to higher doses than adults while breast feeding. In addition, infants are susceptible to adverse developmental effects caused by these substances.

Two steps are used to estimate infant exposure to dioxins through breast milk as per the HHRAP guidance. First, the concentration of dioxins in milk fat of breast milk was estimated using the equation described in Table C-3-1 of Appendix G. Second, the average daily dose (ADD) of dioxins for an infant exposed to contaminated breast milk was calculated using the equation described in Table C-3-2 of Appendix G. Variables for the equations are presented in Table 6-1. Results for infant exposure to dioxin are discussed in Section 8.6.5.

8.4 Method for Estimating Acute Inhalation Hazard

The hazard quotient for acute inhalation exposure for each source was estimated using the equation described in Table C-4-1 as per the HHRAP guidance. Variables for the equation are presented in Table 6-1. Acute inhalation exposure criteria (AIECs) used to calculate the hazard quotients are discussed in Section 7. The hazard quotients were then summed across all sources and COPCs. Results for acute inhalation exposure are discussed in Section 8.6.7.

8.5 Target Levels

The target levels for the risk assessment are determined by EPA Region 2 (the permitting authority). If the calculated values for the endpoints are equal to or less than the target levels, no additional evaluation is required. If the calculated values for the endpoints are greater than the target levels, additional analysis of the underlying scientific basis for the calculations is warranted. Depending on the results of any additional analysis, mitigation options may be warranted, which may include modifying the operating conditions of the incinerators, such as feed rates or combustion conditions, or installing pollution control devices. The target levels used for the risk characterization are as follows:

Endpoint	Target Levels
Carcinogenic effects	1×10^{-5}
Noncancer effects	0.25
Acute inhalation hazard	1
Adult, noncancer PCDD/PCDF exposure	1 pg TEQ/kg-day
Nursing infant, noncancer PCDD/PCDF exposure	60 pg TEQ/kg-day
Lead exposure	400 mg/kg

The target level for carcinogenic effects of 1×10^{-5}, or 1 in 100,000, is within the range of 10^{-4} to 10^{-6} outlined in the National Contingency Plan (40 CFR 300.430). The 1×10^{-5} value is interpreted to mean that at the calculated exposure, a person's chance of getting cancer as a result of that exposure is no higher than 1 in 100,000. An alternative interpretation of 1×10^{-5} is that if 100,000 people were all exposed to a chemical at the same levels, a maximum of one excess cancer would occur. Nevertheless, the cancer target levels are interpreted as upper bounds since the actual number of cancers would likely be less and could be zero. As a point of reference, the lifetime cancer rate from all causes in the United States is slightly less than 1 in 2 for males and a little more than 1 in 3 for females (American Cancer Society, 2006).

For non-cancer effects, no adverse health effects are predicted if the HI is less than one (EPA, 1989). However, the four-times-more-protective target level HI of 0.25 is selected as a method to account for potential, existing exposures from sources other than those from facility emissions. It should be noted that the HI does not represent a statistical probability. For example, a HI of 0.001 does not mean that there is a one in a thousand chance of the effect occurring. Rather, it means that the hazard is one thousandth less than a level which would likely result in an adverse health effect.

The target level for acute inhalation exposures is a HI of one. No adverse health effects are predicted if the HI is one or less. The potential for existing acute inhalation exposures from sources other than those at the facility is judged to be small for the 1-hour exposure time.

The target level for evaluating noncancer PCDD/PCDF exposure is to compare PCDD/PCDF oral exposure estimates to national background exposure levels, using 1 pg TEQ/kg-day for adults and 60 pg TEQ/kg-day for nursing infants (EPA, 2005a). If the calculated values for the noncancer endpoints are less than the target levels, the conclusion is that potential exposures to emissions are safe. A calculated value greater than the target level does not indicate an unsafe action or an unacceptable risk but does indicate that additional evaluation or mitigation is warranted.

Lead concentrations in soil are initially compared to a benchmark level of 400 mg/kg. If lead concentrations are above the benchmark level, EPA recommends evaluating lead exposure using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead in children (EPA, 2005a). When the IEUBK model is run with standard recommended default values, which generally represent national averages, the model predicts that no more than 5 percent of children exposed to a lead concentration in soil of 400 mg/kg will have lead concentrations in blood exceeding 10 ug/dL (EPA, 1994a and 1994b). Since children are more susceptible to lead exposure than adults, the benchmark level of 400 mg/kg is also protective for adult exposure.

8.6 Risk Description

Potential cancer risks and noncancer hazards were evaluated for the scenarios discussed in Section 4 as follows:

- Resident, adult and child
- Fisher, adult and child
- Farmer, adult and child
- School Child (Jobos)

Exposure pathways evaluated were direct inhalation of vapors and particulates, soil ingestion, produce ingestion, animal products ingestion, and/or fish ingestion as discussed in Section 4. Estimated exposure to nursing infants is evaluated separately under each adult scenario. An evaluation of exposure to lead is also discussed for each scenario. Risks and hazards were compared to target levels discussed in Section 8.5.

8.6.1 Evaluation of Resident Scenario

Resident adult and child exposures were evaluated for the location (current and future) that showed the greatest emissions exposure as discussed in Section 4. Exposure from direct inhalation of vapors and particulates, soil ingestion, and produce ingestion were evaluated.

Risk and hazard estimates for each source and the total risk across all sources for the resident adult and child are summarized in Table 8-1. Total cancer risks for the resident adult and child were 5.6E-07 and 1.5E-07, respectively. Hazard indices for the resident adult and child were 0.11 and 0.13, respectively. None of the risks and hazards exceeded target levels, however, which indicate no adverse effect from facility emissions.

The risks and hazards for the resident adult and child from various perspectives to assist with transparency and clarity for the risk and hazard estimates are presented in Tables 8-2 through 8-7. Tables 8-2 and 8-3, respectively, show the risk and hazard for each resident adult and child exposure pathway. Tables 8-4 and 8-5, respectively, show the cancer risk for each COPC across all sources for the resident adult and child. Tables 8-6 and 8-7, respectively, show the noncancer hazard for each COPC across all sources for the resident adult and child.

The greatest source of cancer risk and noncancer hazard for the resident adult and child was from inhalation followed by produce ingestion. Scrubber emissions followed by stack emissions contributed the most to cancer risk for the resident adult and child. Scrubber emissions also contributed the most to noncancer hazard for the resident adult and child, followed by Area 1 emissions for the resident adult and stack emissions for the resident child. Chloroform followed by methylene chloride contributed the most to the cancer risk for the resident adult and child. Chloroform followed by Aroclor 1016 contributed the most to noncancer hazard for the resident child and adult. As discussed above, none of the risks and hazards exceed target levels.

8.6.2 Evaluation of Fisher Scenario

Fisher adult and child exposures were evaluated for the location (current and future) that showed the greatest emissions exposure as discussed in Section 4. Exposure from direct inhalation of vapors and particulates, soil ingestion, produce ingestion, and fish ingestion were evaluated.

Risk and hazard estimates for each source and the total risk across all sources for the fisher adult and child are summarized in Table 8-1. Total cancer risks for the fisher adult and child were

1.6E-06 and 3.0E-07, respectively. Hazard indices for the fisher adult and child were 0.24 and 0.23, respectively. None of the risks and hazards exceeded target levels, however, which indicate no adverse effect from facility emissions.

The risks and hazards for the fisher adult and child from various perspectives to assist with transparency and clarity for the risk and hazard estimates are presented in Tables 8-2, 8-3, and 8-8 through 8-11. Tables 8-2 and 8-3, respectively, show the risk and hazard for each fisher adult and child exposure pathway. Tables 8-8 and 8-9, respectively, show the cancer risk for each COPC across all sources for the fisher adult and child. Tables 8-10 and 8-11, respectively, show the noncancer hazard for each COPC across all sources for the fisher adult and child. As discussed above, none of the risks and hazards exceed target levels.

The greatest source of cancer risk and noncancer hazard for the fisher adult and child was from fish consumption followed by inhalation. Stack emissions followed by scrubber emissions contributed the most to cancer risk and noncancer hazard for the fisher adult and child. Aroclor 1254 followed by coplanar PCBs contributed the most to the cancer risk for the fisher adult and child. Chloroform followed by methyl mercury contributed the most to noncancer hazard for the fisher adult and child. As discussed above, none of the risks and hazards exceed target levels.

8.6.3 Evaluation of Farmer Scenario

Farmer adult and child exposures were evaluated for the location (current and future) that showed the greatest emissions exposure as discussed in Section 4. Exposure from direct inhalation of vapors and particulates, soil ingestion, produce ingestion, and animal products ingestion were evaluated.

Risk and hazard estimates for each source and the total risk across all sources for the farmer adult and child are summarized in Table 8-1. Total cancer risks for the farmer adult and child were 1.3E-08 and 2.6E-09, respectively. Hazard indices for the farmer adult and child were 0.0012 and 0.0017, respectively. None of the risks and hazards exceeded target levels, however, which indicate no adverse effect from facility emissions.

The risks and hazards for the farmer adult and child from various perspectives to assist with transparency and clarity for the risk and hazard estimates are presented in Tables 8-2, 8-3, and 8-12 through 8-15. Tables 8-2 and 8-3, respectively, show the risk and hazard for each farmer adult and child exposure pathway. Tables 8-12 and 8-13, respectively, show the cancer risk for

each COPC across all sources for the farmer adult and child. Tables 8-14 and 8-15, respectively, show the noncancer hazard for each COPC across all sources for the farmer adult and child. As discussed above, none of the risks and hazards exceed target levels.

The greatest source of cancer risk for the farmer adult and child was from milk consumption followed by beef consumption for the farmer adult and by inhalation for the farmer child. The greatest source of noncancer hazard for the farmer adult and child was also from milk consumption followed by inhalation for the farmer adult, and by inhalation or product ingestion by the farmer child. Stack emissions followed by scrubber emissions contributed the most to cancer risk and noncancer hazard for the farmer adult and child. Aroclor 1254 followed by coplanar PCBs contributed the most to the cancer risk for the farmer adult and child. Aroclor 1016 followed by Aroclor 1254 contributed the most to noncancer hazard for the farmer adult and child. As discussed above, none of the risks and hazards exceed target levels.

8.6.4 Evaluation of School Child in Jobos

Child exposure was evaluated for the location within the Jobos area that showed the greatest emission exposure as discussed in Section 4.1.4. The purpose was to evaluate exposure to school children. The exposure assumptions for the Jobos child were the same as used for the child resident. Modeled air concentrations for the Jobos receptor location were used. The Jobos exposure location is about 1.3 km east-northeast of the facility emissions area (see Figure 4-5). Exposure from direct inhalation of vapors and particulates, soil ingestion, and produce ingestion were evaluated.

Risk and hazard estimates for each source and the total risk across all sources for the Jobos school child are summarized in Table 8-1. The total risks and hazards for the Jobos school child were more than 12 times less than for the child resident exposure discussed in Section 8.6.1. The total cancer risk for the Jobos school child was 1.2E-08. The hazard index for the Jobos school child was 0.011. The risk and hazard did not exceed target levels, which indicate no adverse effect from facility emissions.

The risks and hazards for the for the Jobos school child from various perspectives to assist with transparency and clarity for the risk and hazard estimates are presented in Tables 8-2, 8-3, 8-16 through 8-17. Tables 8-2 and 8-3, respectively, show the risk and hazard for each Jobos school child exposure pathway. Table 8-16 shows the cancer risk for each COPC across all sources for the Jobos school child . Table 8-17 shows the noncancer hazard for each COPC across all

sources for the Jobos school child . As discussed above, none of the risks and hazards exceed target levels.

The greatest source of cancer risk and noncancer hazard for the Jobos school child was from inhalation followed by produce ingestion. Stack emissions followed by scrubber emissions contributed the most to cancer risk and noncancer hazard for the Jobos school child. Aroclor 1254 followed by near equal values from coplanar PCBs and chloroform contributed the most to the cancer risk for the Jobos school child. Chloroform followed by Aroclor 1016 contributed the most to noncancer hazard for the Jobos school child. As discussed above, none of the risks and hazards exceed target levels.

8.6.5 Evaluation of PCDD/PCDF Noncancer Hazards

Noncancer hazards for nursing infants and adults are evaluated by comparing PCDD/PCDF ADDs to target levels discussed in Section 8.5. The ADDs discussed in this section include coplanar PCBs. For purposes of the discussion, the ADDs (PCDD/PCDF and coplanar PCBs) are described as dioxin ADDs.

Dioxin ADDs for a nursing infant exposed to contaminated breast milk for resident, fisher, and farmer exposures are presented in Table 8-18. The greatest nursing infant dioxin ADD of 0.38 pg TEQ/kg-day occurred for the fisher infant. This value did not exceed the target level of 60 pg TEQ/kg-day, which indicates no adverse effect from facility emissions.

Dioxin ADDs for adult resident, fisher, and farmer exposures are also presented in Table 8-18. Since the IRAP-h View risk calculation software did not give a direct output for adult dioxin ADD, values were calculated utilizing the infant breast milk equations discussed in Section 8.3. Details of the calculations are presented in Appendix H. The results show that the greatest adult dioxin ADD of 0.013 pg TEQ/kg-day occurred for the adult fisher. This value did not exceed the target level of 1 pg TEQ/kg-day, which indicates no adverse effect from facility emissions.

8.6.6 Evaluation of Lead Exposure

Lead concentrations in soil at the resident, fisher, farmer, and Jobos school child exposure locations are presented in Table 8-19. COPC concentrations in soil, including lead, were estimated using the method discussed in Section 5. The greatest lead concentration of 2.0E-05 mg/kg occurred for the resident and fisher exposure scenario. This lead concentration is

significantly below the target level of 400 mg/kg, which indicates no adverse effect from facility emissions.

8.6.7 Evaluation of Acute Inhalation Hazard

Acute inhalation hazards at the resident, fisher, farmer, and Jobos school child exposure locations are presented in Table 8-20. The greatest acute inhalation hazard of 0.0049 occurred for the resident and fisher exposure scenario. This value was significantly below the target level of 1, which indicates no adverse effect from facility emissions.

8.7 Documentation of Results

Documentation of the risk and hazard results produced by the IRAP-h View risk calculation software is presented in Appendix H. A look-up table is included in Appendix H to assist with identification of the various IRAP-h View output files.

9.0 Uncertainties

Uncertainty can be introduced into a human health risk assessment at every step of the process. Uncertainty occurs because risk assessment is a complex process, requiring the integration of the following:

- Release of pollutants into the environment
- Fate and transport of pollutants, in a variety of different and variable environments, by processes that are often poorly understood or too complex to quantify accurately
- Potential for adverse health effects in humans, as extrapolated from animal studies
- Probability of adverse effects in a human population that is highly variable genetically, and in age, activity level and lifestyle.

A number of conservative, or health-protective, assumptions and approximations have been made in calculating risks to humans, particularly where actual toxicological, sampling, and/or modeling data do not exist. As a result, every aspect of a risk assessment contains sources of uncertainty. By definition, the exact degree of uncertainty cannot be defined, but a qualitative discussion of uncertainty can help risk managers understand the approach for this HHRA.

The primary sources of uncertainty in the risk characterization are associated with the dose-response evaluation (toxicity assessment of the compounds of potential concern). It is well known that there is significant uncertainty associated with current assessments of the toxicity of various chemicals. Sources of uncertainty in current toxicity assessments for various chemicals may include a paucity of toxicological data, a need to extrapolate from animals to humans, a need to extrapolate from high to low doses and a lack of knowledge regarding the interactions among various chemicals. The regulatory approach to dealing with these sources of uncertainty is to apply conservative extrapolation methods or safety factors in deriving dose-response parameters (e.g., cancer slope factors and reference doses).

In terms of protecting public health, preventing underestimation of the risk is far more important than calculating the exact risk for a given population. For this reason, only high-end risks are calculated which are likely to overestimate the risk to most exposed individuals. It is therefore

understood that following the HHRAP guidance used herein has likely overestimated the actual risk to public health and the environment.

Because uncertainty is multiplied with every assumption, risks due to pathways involving many assumptions are inherently more highly overestimated than pathways of direct exposure. In addition, assumptions used to bridge data gaps in a risk assessment are intentionally conservative so that risks will not be underestimated. Use of site-specific data wherever possible allows for a more accurate risk assessment.

The exposure assessment depends heavily on fate and transport models, projection of land use, and assumptions about the frequency and duration of the exposure. Each is a potential source of uncertainty. The sources and magnitude of the uncertainties associated with the exposure assessment may vary greatly from one risk assessment to another. These uncertainties are largely determined by the media, chemicals, populations, pathways, data, and models involved in the assessment.

In addition, there are many chemicals for which there is little information about degradation, partitioning between media, reactions in the environment, uptake by plants and animals, absorption rates in humans or the toxic effects of chronic, low-dose exposure. Because of the paucity of data, these gaps in information must be bridged by simplification and assumption, and cannot be modeled in the same way as facts.

Tentatively Identified Compounds

During the Comprehensive Performance Test (CPT) conducted on the incinerators in March/April 2006, a number of organic compounds were detected in stack gas at levels above respective detection limits. As discussed in Section 2.3, all of these compounds were retained for quantitative analysis in this risk assessment with the exception of dimethyl phthalate which is attributed to laboratory contamination.

In addition to those organic compounds detected during the CPT, a number of volatile and semivolatile organic compounds were tentatively identified in stack gas by the analytical laboratory (TRC, 2006). These tentatively identified compounds (TICs) are identified in Table 9-1 (volatile TICs) and Table 9-2 (semi-volatile TICs).

Of the seven volatile TICs and six semivolatile TICs identified, toxicity information is available for only one compound - benzaldehyde. Qualitative evaluation of this compound in accordance with HHRAP guidance demonstrates that any incremental hazard associated with benzaldehyde emissions is insignificant, as described below.

The oral RfD for benzaldehyde is 0.1 mg/kg-d. The estimated emission rate of benzaldehyde during the CPT was approximately 8.1E-10 g/s (based on a maximum catch of 8.8 ug during Run 2 of Test 1 over a sampling period of three hours). Methylene chloride, with an oral RfD of 0.06 mg/kg-d may be conservatively used as a surrogate for benzaldehyde. The maximum emission rate of methylene chloride during the CPT was 8.57E-08 g/s (during Run 3 of Test 1). As described in Chapter 8 of this HHRA, non-carcinogenic hazards associated with methylene chloride emissions are insignificant, ranging from 9.61E-07 for the farmer child to 3.45E-04 for the fisher child. Since benzaldehyde has a lower toxicity and a lower emission rate than methylene chloride, it can be concluded that hazards associated with emissions of benzaldehyde are also insignificant.

Unidentified Organic Compounds

Total organic emissions (TOE) testing was performed as part of the CPT for the incinerators. The goal of the TOE testing was to determine the fraction of unidentified organic constituents in the stack gas. The TOE represents the approximate total emissions of all identifiable and unidentifiable organic emissions and is the sum of the total volatile organic fraction, the total semivolatile fraction, and the total gravimetric fraction as determined from the TOE test methods (see Table 7-1 of Appendix B). In comparison, the total organic COPC emissions represent the sum of all organic compounds detected during the CPT. The fraction of unidentified organic constituents is equal to the ratio of TOE emissions to the total organic COPC emissions. For the TAPI incinerators, this fraction, or "TOE factor," is approximately 5.5. Derivation of the TOE factor is presented in Table 9-3.

The TOE data show that there is an uncertainty in the risk calculations due to the unidentified organic constituents. Since the TOE methods do not determine the exact nature of the unidentified constituents, it is not possible to provide a quantitative evaluation of any additional risk. Risks associated with unidentified organic compounds in stack gas are therefore evaluated qualitatively in accordance with HHRAP guidance.

The most toxic, persistent, and bioaccumulative chemicals, such as PCDDs/PCDFs, PCBs, PAHs, and heavy metals, have been identified by the detailed stack gas testing and have been accounted for in the quantitative risk assessment. It is unlikely that other such chemicals exist in the stack emissions, including the unidentified organic fraction as described above, since they are not present in waste feed and were not detected during CPT stack testing under worst case waste feed and incinerator operating conditions.

The conservative nature of the quantitative risk assessment and the many factors of safety incorporated into the quantitative analysis account for much of the uncertainty associated with unidentified organic constituents.

10.0 Ecological Evaluation

The objective of this section is to evaluate the potential for ecological receptors in the vicinity of the TAPI facility to be exposed to, and to be adversely affected by, COPCs being emitted by TAPI's hazardous waste incinerators and associated waste management facilities. Concentrations of COPCs in soil, surface water, and sediment as developed in Section 5 of this risk assessment are compared to appropriate ecological screening levels. Exceedance of a screening level indicates potential impact to ecological receptors and triggers further assessment. Media concentrations below screening levels indicate that adverse effects to ecological receptors are not reasonably expected.

The following sections provide a brief summary of the ecological setting, the basis for media concentrations of COPCs, selection of ecological screening levels, and conclusions.

10.1 Ecological Setting

10.1.1 Terrestrial and Wetland Features

The Guayama area is within the subtropical dry forest area of Puerto Rico. The subtropical dry forest covers substantial areas in southern Puerto Rico and is the driest life zone of the six mapped in Puerto Rico. The mean annual rainfall in the subtropical dry forest area is 60-110 centimeters (USGS 1998). Land cover within this subtropical dry forest area is mapped as a combination of urban and barren land, agriculture/hay/pasture land, and forest-flooded land along portions of the coastline (USDA, 2002).

Regional Plant and Wildlife

The description of the regional plant and wildlife in Puerto Rico is summarized from information presented in USGS (1998).

The vegetation of the subtropical dry forest zone forms a complete ground cover, and on most soils the trees are almost leafless during the dry season. Many of the tree species common on the north side of Puerto Rico are absent on the island's southern side. The subtropical dry zone supports a few species adapted to arid conditions. Palms are generally absent from the dry south side of the island. Plants often have small, succulent or leathery leaves, and plants with thorns and spines are common. Trees are usually less than 15 meters tall with sparse foliage.

The trees of the dry coastal forest include gumbo limbo, mesquite, oxhorn bucida, common lignumvitae, red manjack, and indio. Mangroves line the coasts of the subtropical dry forest zone. Forests of this life zone have more bird species than the wetter life zones, although lizard and frog populations are larger in wetter zones.

A total of 239 native bird species live in Puerto Rico. Many non-indigenous bird species were introduced to the islands over the last 200 years. Puerto Rico has no large wild mammals. The mongoose was brought in to control rats on sugar cane plantations. Bats are the only native terrestrial mammals left on Puerto Rico.

Wetlands

The U.S. Fish and Wildlife Service (USFWS) wetlands map for the vicinity of the site shows no wetlands on the TAPI property (USFWS, 2005). Wetlands areas do exist however to the south and west of the site. To the south, wetlands extend from approximately 0.5 km from the TAPI facility to the Caribbean Sea. To the west, wetlands extend from approximately 1.0 km to the Bahia de Jobos. Wetlands in these areas are generally classified as either freshwater emergent wetlands, freshwater forested/shrub wetlands, or estuarine and marine wetlands.

10.1.2 Surface Water Features

The major surface water feature in the vicinity of the facility is Bahia de Jobos, the second largest bay on the island. The location of Bahia de Jobos is shown in Figure 4-4. Bahia de Jobos has shallow water with a muddy and grassy bottom and is surrounded by mangrove forests. Further inland are palms, swamp ferns, cattails and other freshwater vegetation (NOAA, 2004).

Seagrasses in the bay provide nutrients and habitats to sustain coastal fishery resources. Seagrass beds sometimes serve as nurseries for young reef fishes. Most fishes found in Bahia de Jobos are not likely to spend their entire life in the bay, instead they use the bay as nursery and feeding grounds.

No information specific to marine invertebrates in the Bahia de Jobos was available. Marine invertebrates found in the Caribbean include shrimps, Caribbean spiny lobster, stone crab, conches, and corals.

The West Indian manatee is known to forage within the Bahia de Jobos area. The Hawksbill sea turtle has been seen near the seagrass area. The West Indian manatee and the Yellow-shouldered

blackbird are both ~~threatened~~ endangered species.

10.1.3 Ecologically Sensitive Features

A data base search of threatened and endangered species within the vicinity of the facility was conducted. Table 10-1 lists the threatened and endangered species identified within the area of Guayama, Cayey, and Patillas in Puerto Rico (USFWS, 2006). There are no critical habitats mapped in the Guayama, Cayey, and Patillas areas of Puerto Rico.

10.2 Media Concentrations

In Section 5 of this HHRA, concentrations of COPCs in media were calculated in accordance with HHRAP methodologies. COPC concentrations in soil, surface water, and sediment used in this ecological evaluation are summarized below.

Soil – COPC concentrations in soil were calculated by summing vapor phase and particle phase deposition of COPCs. Wet and dry deposition was considered. Soil concentrations were adjusted to account for losses by several mechanisms as described in Section 5.2. The average COPC concentrations in soil within the Bahia de Jobos watershed are presented in Table 10-2 for organic COPCs and Table 10-3 for metal COPCs. The Bahia de Jobos watershed was selected as the area for evaluation due to its location generally downwind of the TAPI facility and, due to its relatively undeveloped nature, it is the area where potential ecological receptors most likely exist.

Surface water – COPC concentrations in surface water were calculated by considering direct wet and dry deposition into the water body, runoff from watershed areas impacted by deposition of COPCs, and direct diffusion of COPCs into surface water, as described in Section 5.7. The average dissolved COPC concentrations in surface water in Bahia de Jobos are presented in Table 10-4 for organic COPCs and Table 10-5 for metal COPCs. Bahia de Jobos was selected as the water body for evaluation due to its location generally downwind of the TAPI facility and the reportedly diverse fish and plant life within the bay.

Sediment – COPC concentrations in Bahia de Jobos sediment are based on predicted partitioning of COPCs from surface water to sediment as described in Section 5.7. The average COPC concentrations in sediment in Bahia de Jobos are presented in Table 10-6 for organic COPCs and Table 10-7 for metal COPCs.

10.3 Ecological Screening

In this section, media concentrations in soil, surface water, and sediment are compared to ecological screening levels (ESLs). The ESLs represent conservative thresholds for adverse effects levels for long term (chronic) exposure. If a chemical concentration exceeds an ESL, further analysis may be needed to assess any impact posed by that chemical. If, however, the chemical concentration falls below the ESL, the chemical is eliminated from further study (EPA, 1997).

10.3.1 Soil Screening Levels

Screening levels for soil were derived to be protective of various terrestrial endpoints including plant, soil invertebrate, mammal, and bird. ESLs for soil are presented in Tables 10-2 and 10-3. The ESLs selected for soil were obtained using the following hierarchy:

- For organic compounds in soil, the lower of the EPA Region 5 ESLs (EPA 2003) and EPA Region 4 ecological screening values (ESVs) (EPA 1999b) was selected. There are no federal Ecological Soil Screening Levels (Eco-SSLs) (EPA 2005b) currently available for organic compounds.

- For metals with Eco-SSLs for one or more endpoints, including the mammalian endpoint, the lowest of the Eco-SSL values for all endpoints was selected. Eco-SSLs are soil screening numbers, and as such are not appropriate for use as cleanup levels. Screening ecotoxicity values are derived to avoid underestimating risk.

- For metals with Eco-SSLs for endpoints not including the mammalian endpoint, the lowest value of the available Eco-SSLs, EPA Region 5 ESLs or EPA Region 4 ESVs was selected.

- Soil ESLs were not available for acetaldehyde, dioxins, formaldehyde, methanol, and propionaldehyde.

10.3.2 Surface Water Screening Levels

ESLs for surface water are concentrations protective of aquatic life. ESLs for surface water are presented in Tables 10-4 and 10-5. Surface water ESLs were selected using the following hierarchy:

- Puerto Rico Environmental Quality Board (PREQB, 2003) Standards applicable to aquatic life for Class SC waters. Class SC waters are defined as coastal and estuarine waters intended for use in primary and secondary contact recreation, and for propagation and preservation of desired species, including threatened or endangered species.

- EPA ambient water quality standards for protection of aquatic life in saltwater for continuous exposure (EPA, 2002). Chronic standards incorporate adverse effects on growth, reproductive success, and survival over all or most of the lifecycle of the test organism.

- EPA Region 4 surface water screening values for saltwater (EPA 2001b). EPA Region 4 screening values were compiled from various water quality criteria documents and represent the chronic ambient water quality criteria values for protection of aquatic life.

- Tier II benchmark values developed by the Oak Ridge National Laboratory (ORNL, 1996) to establish benchmarks with fewer data than are required for the NAWQC. Tier II benchmarks were developed for freshwaters.

- Surface water ESLs were not available for furans, methanol, and propionaldehyde.

10.3.3 Sediment Screening Levels

ESLs for sediment are concentrations derived for the protection of benthic organisms. Preference was given to ESLs developed for marine environments. ESLs for sediment are presented in Tables 10-6 and 10-7. The ESLs were selected from the following sources:

- National Oceanic and Atmospheric Administration (NOAA) screening concentrations for marine sediment (NOAA, 1999). The NOAA threshold effects levels (TELs) were used for screening. These values represent concentrations below which adverse effects are rarely expected to occur.

- EPA Region 4 sediment screening values for hazardous waste sites (EPA 2001b). The EPA Region 4 values are primarily based on marine environments.

- EPA EcoTox thresholds (EPA 1996). EcoTox thresholds are media-specific contaminant concentrations above which there is sufficient concern regarding adverse ecological effects to warrant further evaluation.

- EPA Region 5 ESLs for sediment (EPA 2003). EPA Region 5 ESLs for sediment are values that can be used for initial screening levels to use in ecological risk assessments. EPA Region 5 ESLs are for freshwaters and are used where no saltwater values are available.

- ESLs for sediment were not available for acetaldehyde, formaldehyde, furans, methanol, methylene chloride, propionaldehyde, barium, beryllium, selenium, and thallium.

10.4 Discussion and Conclusions

This section presents the results of the comparison of media concentrations in soil, surface water, and sediment to ESLs and the conclusions of the ecological evaluation.

In soil, all COPC concentrations were below the ESLs as shown on Tables 10-2 and 10-3. No COPCs are at concentrations in soil that could cause an adverse effect to ecological receptors for long term exposure. No further evaluation of COPCs in soil is required.

In surface water, all COPC concentrations were below the ESLs as shown on Tables 10-4 and 10-5. No COPCs are at concentrations in surface water that could cause an adverse effect to ecological receptors for long term exposure. No further evaluation of COPCs in surface water is required.

In sediment, all COPC concentrations were below the ESLs as shown on Tables 10-6 and 10-7. No COPCs are at concentrations in sediment that could cause an adverse effect to ecological receptors for long term exposure. No further evaluation of COPCs in sediment is required.

In conclusion, no COPCs were calculated to be present in soil, surface water, or sediment at concentrations that may indicate a potential adverse effect on ecological receptors. Therefore, it is not reasonable to expect adverse impacts to ecological receptors due to operation of the TAPI incinerators and associated facilities. No further assessment of ecological effects is warranted.

11.0 Conclusions

TAPI Puerto Rico Inc. conducted a human health risk assessment (HHRA) to demonstrate that operation of the two hazardous waste incinerators and associated RCRA hazardous waste storage tanks and equipment located at its Guayama, Puerto Rico manufacturing facility do not pose unacceptable risk to human health. The methodology employed in conducting the HHRA is consistent with that presented in *Human Health Risk Assessment Protocol for Hazardous Waste Combustor Facilities* (EPA, 2005a).

The HHRA addresses direct and indirect exposure to incinerator stack emissions as well as fugitive emissions from RCRA tanks and equipment. Both carcinogenic risk and non-carcinogenic hazards were evaluated for all exposure scenarios. Exposure scenarios quantitatively evaluated in the HHRA included farmer, farmer child, resident, resident child, fisher, fisher child, and acute receptor. Exposure pathways evaluated were direct inhalation of vapors and particulates, soil ingestion, produce ingestion, animal products ingestion, and/or fish ingestion.

Risk calculations were performed with the Industrial Risk Assessment Program - Human Health Software (IRAP-h View, version 3.1) developed by Lakes Environmental Software (2006), which estimates COPC media concentrations, intakes, risk, and hazard in accordance with the HHRAP guidance. Lakes Environmental Software reports that the software has been validated by EPA Regions 4 and 6.

The HHRA demonstrated that the hazardous waste incinerators and associated tanks and equipment do not pose an unacceptable risk to human heath. Predicted increases in cancer were compared to the EPA guideline of 1.0E-05. Non-cancer health effects were compared to the EPA guideline Hazard Index (HI) of 0.25. Findings are summarized below.

- The exposure scenario subject to the greatest incremental cancer risk is the fisher. The incremental cancer risk is 1.6E-06 for the fisher adult. The exposure pathway contributing most significantly to this risk is fish consumption. COPCs contributing most significantly include total and coplanar PCBs. These incremental risks are well within acceptable EPA guidelines.

- The exposure scenario subject to the greatest non-cancer hazard is also the fisher. The non-cancer HI is 0.24 for the fisher adult. The exposure pathway contributing most significantly to this hazard is fish consumption. The COPCs contributing most significantly are methyl mercury and chloroform. These hazards are within acceptable EPA guidelines.

An uncertainty analysis was performed as part of the HHRA in order to identify and interpret factors which may affect quantitative assessment of risks and hazards. The analysis identified a number of areas at which uncertainty is introduced into the risk assessment process. However, it was concluded any such uncertainty, which is inherent in the risk assessment process, does not significantly affect the findings and conclusions of this HHRA.

As part of this HHRA, a qualitative evaluation of potential impact to ecological receptors was performed. Appropriate ecological screening levels were identified and compared to predicted concentrations of compounds of potential concern in soil, surface water, and sediment. It was determined that in no case did media concentrations exceed corresponding ecological screening levels. It is therefore concluded that there is no indication of impact to ecological receptors and that further assessment of ecological impact is not required.

In conclusion, operation of the TAPI hazardous waste incinerators and associated hazardous waste management units have been found to pose no unacceptable risk to human health or the environment.

12.0 References

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Tables

Table 2-1
Selection of Organic Compounds of Potential Concern
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Constituent	RCRA Appendix VIII Hazardous Constituent?	Hazardous Air Pollutant?	Detected in Stack Gas?	Detected in Waste Analysis?	Present Based on Process Knowledge?	Retained as Compound of Potential Concern?
Dioxin/furan	yes	yes	yes	no	no	yes
PCBs	yes	yes	yes	no	no	yes
acetone	no	no	yes	yes	yes	yes
methylene chloride	yes	yes	yes	yes	yes	yes
n-butyl alcohol	no	no	no	yes	yes	no
isopropyl alcohol	no	no	no	yes	yes	no
ethyl acetate	no	no	no	yes	yes	no
toluene	yes	yes	no	yes	yes	yes
ethanol	no	no	no	yes	no	no
xylene	yes	yes	no	yes	yes	yes
chloroform	yes	yes	no	no	yes	yes
methanol	no	yes	no	no	yes	yes
cyclohexane	no	no	no	no	yes	no
cyclohexanone	no	no	no	no	yes	no
ethyl ether	no	no	no	no	yes	no
dimethyl pthalate	yes	yes	yes (1)	no	no	no
fluoranthene	yes	no	yes	no	no	yes
pyrene	no	no	yes	no	no	yes
formaldehyde	yes	yes	yes	no	no	yes
acetaldehyde	no	yes	yes	no	no	yes
propionaldehyde	no	yes	yes	no	no	yes

(1) suspected laboratory contaminant

Table 2-2
Compounds of Potential Concern
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Organic Compounds of Potential Concern	Inorganic Compounds of Potential Concern
Dioxin/furan	Antimony
PCBs	Arsenic
acetone	Barium
methylene chloride	Beryllium
toluene	Cadmium
xylene	Chromium
chloroform	Lead
methanol	Mercury
fluoranthene	Nickel
pyrene	Selenium
formaldehyde	Silver
acetaldehyde	Thallium
propionaldehyde	Zinc

Table 2-3
Dioxin/Furan Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc
Guayama, Puerto Rico

Congener	CPT Maximum Emission Result (lb/hr)	Emission Rate (g/s)	CPT Test Run	Emission Rate Considering Process Upsets [1] (g/s)	TEF [2] (unitless)	TEQ Emission Rate Considering Process Upsets[1][3] (g/s)
2,3,7,8-TCDD	1.70E-11	2.14E-12	4	2.53E-12	1	2.53E-12
1,2,3,7,8-PeCDD	1.90E-11	2.40E-12	3	2.83E-12	1	2.83E-12
1,2,3,4,7,8-HxCDD	1.90E-11	2.40E-12	3	2.83E-12	0.1	2.83E-13
1,2,3,6,7,8-HxCDD	4.50E-11	5.68E-12	3	6.70E-12	0.1	6.70E-13
1,2,3,7,8,9-HxCDD	2.30E-11	2.90E-12	3	3.42E-12	0.1	3.42E-13
1,2,3,4,6,7,8-HpCDD	1.10E-10	1.39E-11	3	1.64E-11	0.01	1.64E-13
1,2,3,4,6,7,8,9-OCDD	1.20E-10	1.51E-11	1	1.79E-11	0.0001	1.79E-15
2,3,7,8-TCDF	6.30E-12	7.95E-13	4	9.38E-13	0.1	9.38E-14
1,2,3,7,8-PeCDF	7.90E-11	9.96E-12	3	1.18E-11	0.05	5.88E-13
2,3,4,7,8-PeCDF	1.80E-10	2.27E-11	3	2.68E-11	0.5	1.34E-11
1,2,3,4,7,8-HxCDF	2.30E-10	2.90E-11	3	3.42E-11	0.1	3.42E-12
1,2,3,6,7,8-HxCDF	2.60E-10	3.28E-11	3	3.87E-11	0.1	3.87E-12
2,3,4,6,7,8-HxCDF	4.20E-10	5.30E-11	3	6.25E-11	0.1	6.25E-12
1,2,3,7,8,9-HxCDF	4.70E-11	5.93E-12	3	6.99E-12	0.1	6.99E-13
1,2,3,4,6,7,8-HpCDF	6.60E-10	8.32E-11	3	9.82E-11	0.01	9.82E-13
1,2,3,4,7,8,9-HpCDF	1.80E-10	2.27E-11	3	2.68E-11	0.01	2.68E-13
1,2,3,4,6,7,8,9-OCDF	2.00E-10	2.52E-11	3	2.98E-11	0.0001	2.98E-15
					Total	3.64E-11

Notes:
(1) Considering process upsets during 2% of the year, the emission rate has been multiplied by 1.18 as per HHRAP.
(2) TEF - toxicity equivalent factor (with respect to 2,3,7,8-TCDD)
(3) TEQ - toxicity equivalent (with repsect to 2,3,7,8-TCDD)

able 2-4
Coplanar PCB Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico LP
Guayama, Puerto Rico

Constituent	CPT Maximum Emission Rate (g/s)	Emission Rate Considering Process Upsets (g/s)	CPT Test Run	WHO 1998 TEFs (unitless)	TEQ Emission Rate Considering Process Upsets [1] (g/s)
3,3',4,4'-tetrachlorobiphenyl [PCB 77]	6.32E-08	7.46E-08	1	0.0001	7.46E-12
3,4,4',5-tetrachlorobiphenyl [PCB 81]	2.65E-08	3.13E-08	2	0.0001	3.13E-12
2,3,3',4,4'-pentachlorobiphenyl [PCB 105]	7.58E-08	8.94E-08	1	0.0001	8.94E-12
2,3,4,4',5-pentachlorobiphenyl [PCB 114]	2.65E-08	3.13E-08	2	0.0005	1.56E-11
2,3',4,4',5-pentachlorobiphenyl [PCB 118]	1.85E-07	2.18E-07	1	0.0001	2.18E-11
2',3,4,4',5-pentachlorobiphenyl [PCB 123]	2.14E-08	2.53E-08	2	0.0001	2.53E-12
3,3',4,4',5-pentachlorobiphenyl [PCB 126]	0.00E+00	0.00E+00	--	0.1	0.00E+00
2,3,3',4,4',5-hexachlorobiphenyl [PCB 156]	1.77E-08	2.09E-08	3	0.0005	1.04E-11
2,3,3',4,4',5'-hexachlorobiphenyl [PCB 157]	1.77E-08	2.09E-08	3	0.0005	1.04E-11
2,3',4,4',5,5'-hexachlorobiphenyl [PCB 167]	0.00E+00	0.00E+00	--	0.00001	0.00E+00
3,3',4,4',5,5'-hexachlorobiphenyl [PCB 169]	0.00E+00	0.00E+00	--	0.01	0.00E+00
2,3,3',4,4',5,5'-hexachlorobiphenyl [PCB 189]	0.00E+00	0.00E+00	--	0.0001	0.00E+00
		Total TEQ (with respect to 2,3,7,8-TCDD)			***8.04E-11***

Notes:
(1) Considering process upsets during 2% of the year, the emission rate has been multiplied by 1.18 as per HHRAP.

Table 2-5
Total PCB Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico LP
Guayama, Puerto Rico

PCB Class	CPT Maximum Emission Rate (g/s)	CPT Test Run	Emission Rate Considering Process Upsets (g/s)
Monochloropbiphenyl (total)	5.47E-07	1	6.45E-07
Dichlorobiphenyl (total)	4.63E-06	1	5.46E-06
Trichlorobiphenyl (total)	1.43E-05	1	1.69E-05
Tetrachlorobiphenyl (total)	8.00E-06	1	9.44E-06
Pentachlorobiphenyl (total)	2.15E-06	1	2.54E-06
Hexachlorobiphenyl (total)	2.40E-06	1	2.83E-06
Heptachlorobiphenyl (total)	1.14E-06	1	1.35E-06
Octachlorobiphenyl (total)	1.64E-07	3	1.94E-07
Nonachlorobiphenyl (total)	0.00E+00	--	0.00E+00
Decachlorobiphenyl (total)	1.77E-08	3	2.09E-08
		Total PCBs	***3.94E-05***

Notes:
(1) Considering process upsets during 2% of the year, the emission rate has been multiplied by 1.18 as per HHRAP.

Table 2-6
SVOC and Aldehyde Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico, Inc
Guayama, Puerto Rico

Constituent	CPT Maximum Emission Result (lb/hr)	Emission Rate (g/s)	CPT Test Run	Emission Rate Considering Process Upsets [1] (g/s)
Fluoranthene	0.000015	1.46E-06	2	1.72E-06
Pyrene	0.000016	2.05E-06	2	2.42E-06
Acetaldehyde	0.0002	2.52E-05	1	2.98E-05
Formaldehyde	0.00049	6.18E-05	2	7.29E-05
Propionaldehyde	0.0003	3.78E-05	2	4.46E-05

(1) Considering process upsets during 2% of the year, the emission rate has been multiplied by 1.18 as per HHRAP.

Table 2-7
Incinerator Waste Feed Characteristics
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Compound	Waste composition % by weight [1]	
	Aqueous waste	Organic waste
Methylene chloride	0.00	6.00
n-Butanol	1.30	12.00
IPA	3.70	33.00
Ethyl acetate	2.70	24.00
Toluene	0.38	2.00
Ethanol	0.38	3.10
Acetone	0.00	0.70
Methanol	0.00	0.50
Chloroform	0.00	0.50
Xylenes	0.00	0.50
Cyclohexane	0.00	0.50
Cyclohexanone	0.00	0.50
Ethyl ether	0.00	0.50
Water	91.54	16.20
Total	100.00	100.00

(1) Projected hazardous waste composition as provided by TAPI.

Table 2-8
VOC Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Waste Stream Composition	Weight Fraction of Each VOC in Waste Stream (%)		Total Waste [1] (gal/year)		CPT Average Removal Efficiency[2] (%)	Emission Rate (g/s)	Emission Rate Considering Process Upsets[3] (g/s)
	Aqueous Waste	Organic Waste	Aqueous Waste (sp=1)	Organic Waste (sp=0.95)			
Acetone	0.0%	0.7%	2197782.00	649322.00	99.999%	5.183E-06	6.115E-06
Chloroform	0.0%	0.5%	2197782.00	649322.00	99.999%	3.702E-06	4.368E-06
Methanol	0.0%	0.5%	2197782.00	649322.00	99.999%	3.702E-06	4.368E-06
Methylene chloride	0.0%	6.0%	2197782.00	649322.00	99.999%	4.442E-05	5.242E-05
Toluene	0.4%	2.0%	2197782.00	649322.00	99.999%	2.483E-05	2.930E-05
Xylenes	0.0%	0.5%	2197782.00	649322.00	99.999%	3.702E-06	4.368E-06

Notes:

(1) Provided by TAPI
(2) Based on the CPT results, the destruction and removal efficiency of principal organic hazardous constituents is at least 99.999%.
(3) Considering process upsets during 2% of the year, the emission rate has been multiplied by 1.18.

Table 2-9
Metals Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Metal	Maximum Waste Feed Concentration (ug/L)	Total Waste[1] (gal/year)	CPT Average Removal Efficiency [2] (%)	Emission Rate (g/s)	Emission Rate Considering Process Upsets [3] (g/s)
Antimony	500	2,847,104	0.0%	1.709E-04	2.016E-04
Arsenic	384	2,847,104	99.4%	7.873E-07	9.290E-07
Barium	500	2,847,104	97.9%	3.588E-06	4.234E-06
Beryllium	60	2,847,104	97.9%	4.306E-07	5.081E-07
Cadmium	210	2,847,104	99.4%	4.306E-07	5.081E-07
Chromium	1800	2,847,104	97.9%	1.292E-05	1.524E-05
Lead	1500	2,847,104	99.4%	3.075E-06	3.629E-06
Mercury	25	2,847,104	0.0%	8.543E-06	1.008E-05
Nickel	1500	2,847,104	97.9%	1.076E-05	1.270E-05
Selenium	100	2,847,104	0.0%	3.417E-05	4.032E-05
Silver	100	2,847,104	0.0%	3.417E-05	4.032E-05
Thallium	500	2,847,104	99.4%	1.025E-06	1.210E-06
Zinc	1000	2,847,104	99.4%	2.050E-06	2.419E-06

Notes:

(1) Considering two incinerators. Based on the CPT results, the maximum waste flow rate per incininerator is 17.6 L/min
(2) Removal efficiencies for Lead, Arsenic, and Chromium are based on CPT results. Removal efficiencies for other metals based on volatility class.
(3) Based on process upsets 2% of operating time.

Table 2-10
Storage Tank Characteristics
Human Health Risk Assessment
TAPI Puerto Rico Inc
Guayama, Puerto Rico

Tank Characteristic		V-401	V-406	V-408	V-430	V-436	V-604	V-450	V-451	V-452	V-453	V-454
Type of Waste [1]		Aqueous	Aqueous	Aqueous	Organic	Organic	Aqueous	Organic	Organic	Aqueous	Aqueous	Aqueous
Shell Height (ft) [2]		12	12	12	6	12	24	24	24	24	24	24
Shell Diameter (ft) [2]		12	12	12	12	12	12	12	12	12	12	12
Maximum Liquid Height (ft) [3]		11.2	11.2	11.2	5.8	11.2	22.5	22.5	22.5	22.5	22.5	22.5
Average Liquid Height (ft) [4]		8.42	8.42	8.42	4.38	8.42	16.84	16.84	16.84	16.84	16.84	16.84
Working Volume (gal) [5]		9,500	9,500	9,500	4,940	9,500	19,000	19,000	19,000	19,000	19,000	19,000
Turnovers per Year [6]		46.3	46.3	46.3	45.0	45.0	46.3	17.1	17.1	38.6	38.6	38.6
Net Throughput (gal/yr) [6]		439556	439556	439556	222136	427186	879113	324661	324661	732594	732594	732594
Is Tank Heated ? (y/n)		N	N	N	N	N	N	N	N	N	N	N
Shell Characteristics	Color	White	White	White	White	White	White	White	White	White	White	White
	Condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Roof Characteristics	Color	White	White	White	White	White	White	White	White	White	White	White
	Condition	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
	Type	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone	Cone
	Height (ft) [7]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Slope (ft/ft) Cone Roof [8]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Breather Vent Settings [9]	Vacuum (psig)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	Pressure (psig)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

(1) Obtained from TAPI Actual Emissions Sources 2005 report. API projected service for V-430, V-436, V-604, and V-454
(2) Table D-2 RCRA permit
(3) Calculated in Table "Tanks Parameter Calculation" based on RCRA permit data
(4) Estimated by TAPI equal to 75% of maximum liquid height
(5) The actual capacity of the tank is 95% of the design nominal capacity as indicated in Table D-2 RCRA permit
(6) Calculated in Table "Tanks Parameter Calculation" based on TAPI's projected production
(7) Obtained from TAPI Actual Emissions Sources 2005 report.
(8) Calculated based on tank diameter and roof height
(9) Obtained from TAPI Actual Emissions Sources 2005 report.

Table 2-11
Tank Operating Parameter Calculations
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Groups		Vessel	Nominal Capacity (gal)	Actual Capacity (gal)	Projected Annual Production			Parameters to Calculate Liquid Height				Average Liquid Height Estimate	
					Net Stored (gal)	Net Throughput (gal/yr-tank)	Turnovers (year)	Diameter (ft)	Area (ft^2)	Waste SP	Waste Density (gal/ft^3)	Maximum Liquid Height (ft)	Average Liquid Height (ft)
Storage Tanks	Aqueous	V-401	10,000	9,500	2197782	439556	46.3	12.0	113.1	1.00	7.48	11.2	8.42
		V-406	10,000	9,500		439556	46.3	12.0	113.1	1.00	7.48	11.2	8.42
		V-408	10,000	9,500		439556	46.3	12.0	113.1	1.00	7.48	11.2	8.42
		V-604	20,000	19,000		879113	46.3	12.0	113.1	1.00	7.48	22.5	16.84
	Organic	V-430	5,200	4,940	649322	222136	45.0	12.0	113.1	1.00	7.48	5.8	4.38
		V-436	10,000	9,500		427186	45.0	12.0	113.1	1.00	7.48	11.2	8.42
Incinerator's Feed Tanks	Organic	V-450	20,000	19,000	649322	324661	17.1	12.0	113.1	1.00	7.48	22.5	16.84
		V-451	20,000	19,000		324661	17.1	12.0	113.1	1.00	7.48	22.5	16.84
	Aqueous	V-452	20,000	19,000	2197782	732594	38.6	12.0	113.1	1.00	7.48	22.5	16.84
		V-453	20,000	19,000		732594	38.6	12.0	113.1	1.00	7.48	22.5	16.84
		V-454	20,000	19,000		732594	38.6	12.0	113.1	1.00	7.48	22.5	16.84

Table 2-12
Tank Fugitive Emission Summary
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Vessel ID	Loss Calculation from TANKS 4.0.9d (1)			Total Emissions(2) (g/s)
	Working Losses (lbs/year)	Breathing Losses (lbs/year)	Total Losses (lbs/year)	
V-401	22.53	3.27	25.8	3.7142E-04
V-406	22.53	3.27	25.8	3.7142E-04
V-408	22.53	3.27	25.8	3.7142E-04
V-430	433.99	82.4	516.39	7.4341E-03
V-436	834.09	138.73	972.82	1.4005E-02
V-604	45.04	5.47	50.51	7.2715E-04
V-450	760.69	212	972.69	1.4003E-02
V-451	760.69	212	972.69	1.4003E-02
V-452	43.47	5.47	48.94	7.0455E-04
V-453	43.47	5.47	48.94	7.0455E-04
V-454	43.47	5.47	48.94	7.0455E-04

Note
(1) Water vapor contribution has been substracted from TANKS individual summary reports
(2) Based on 365 days/year

Table 2-13
Speciated Fugitive Emission Rates from Tanks
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Waste Stream Component	Losses (lbs/yr) [1]												Emission Rate (g/s)
	Tank V-401	Tank V-406	Tank V-408	Tank V-430	Tank V-436	Tank V-604	Tank V-450	Tank V-451	Tank V-452	Tank V-453	Tank V-454	*Total*	
Methylene chloride	65.69	65.69	65.69	170.59	321.39	128.49	321.34	321.34	124.49	124.49	124.49	*1833.69*	5.2797E-02
n-Butanol alcohol	0.54	0.54	0.54	6.49	12.23	1.06	12.23	12.23	1.03	1.03	1.03	*48.95*	1.4094E-03
IPA	10.07	10.07	10.07	116.57	219.61	19.69	219.58	219.58	19.08	19.08	19.08	*882.48*	2.5409E-02
Ethyl acetate	13.95	13.95	13.95	160.98	303.28	27.28	303.24	303.24	26.43	26.43	26.43	*1219.16*	3.5103E-02
Toluene	0.61	0.61	0.61	4.14	7.80	1.18	7.79	7.79	1.15	1.15	1.15	*33.98*	9.7837E-04
Ethanol	1.33	1.33	1.33	14.10	26.57	2.60	26.57	26.57	2.52	2.52	2.52	*107.96*	3.1084E-03
Acetone	0.00	0.00	0.00	10.98	20.69	0.00	20.69	20.69	0.00	0.00	0.00	*73.05*	2.1033E-03
Methanol	0.00	0.00	0.00	4.58	8.62	0.00	8.62	8.62	0.00	0.00	0.00	*30.44*	8.7644E-04
Chloroform	0.00	0.00	0.00	6.63	12.49	0.00	12.48	12.48	0.00	0.00	0.00	*44.08*	1.2692E-03
Xylene (-m)	0.00	0.00	0.00	0.32	0.60	0.00	0.60	0.60	0.00	0.00	0.00	*2.12*	6.1040E-05
Cyclohexane	0.00	0.00	0.00	3.37	6.35	0.00	6.35	6.35	0.00	0.00	0.00	*22.42*	6.4553E-04
Cyclohexanone	0.00	0.00	0.00	0.18	0.34	0.00	0.34	0.34	0.00	0.00	0.00	*1.20*	3.4551E-05
Ethyl ether	0.00	0.00	0.00	17.45	32.87	0.00	32.87	32.87	0.00	0.00	0.00	*116.06*	3.3417E-03

Note :
(1) Loss calculation was estimated using EPA approved software TANKS 4.0.9d

Table 2-14
Area Source Equipment Leak Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Source ID	Source Area (m^2)	Related HW Management Unit	Type of Waste Stream In Service	Waste Stream	Equipment/ Fitting Type	Number of Each Equipment Type Per Waste Stream (1)	Number of Components with detected emissions during 2005 (2)	Equipment Emission Factors (3)		Total VOC Weight Fraction (4)	Total VOC Emissions Rate by Equipment (g/sec)	Total Fugitive Emission Rate (g/sec)	Total Fugitive Emission Rate (g/sec-m^2)
								(kg/hr)	(g/sec)				
AREA1	840	Vessel V-401	Light Liquid	Aqueous	Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04	1.2468E-02	1.4843E-05
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	7	1	4.0300E-03	1.1194E-03	0.11	1.2829E-04		
					Connectors	0	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	27	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
		Vessel V-406	Light Liquid		Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04		
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	21	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	6	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	67	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
		Vessel V-408	Light Liquid		Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04		
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	18	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	5	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	54	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
		Vessel V-430	Light Liquid	Organic	Pumps	1	1	1.9900E-02	5.5278E-03	0.84	4.6433E-03	1.0440E-02	1.2428E-05
					Mixer	0	0	1.9900E-02	5.5278E-03	0.84	0.0000E+00		
					Valves	18	0	4.0300E-03	1.1194E-03	0.84	0.0000E+00		
					Connectors	5	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
					Flanges	54	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
		Environmetal-Incinerators	Light Liquid		Pumps	0	0	1.9900E-02	5.5278E-03	0.84	0.0000E+00		
					Mixer	0	0	1.9900E-02	5.5278E-03	0.84	0.0000E+00		
					Valves	193	3	4.0300E-03	1.1194E-03	0.84	2.8143E-03		
					Connectors	296	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
					Flanges	297	7	1.8300E-03	5.0833E-04	0.84	2.9819E-03		

Table 2-14
Area Source Equipment Leak Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico
2 of 3

Source ID	Source Area (m^2)	Related HW Management Unit	Type of Waste Stream In Service	Waste Stream	Equipment/ Fitting Type	Number of Each Equipment Type Per Waste Stream [1]	Number of Components with detected emissions during 2005 [2]	Equipment Emission Factors [3]		Total VOC Weight Fraction [4]	Total VOC Emissions Rate by Equipment (g/sec)	Total Fugitive Emission Rate (g/sec)	Total Fugitive Emission Rate (g/sec-m^2)
								(kg/hr)	(g/sec)				
AREA2	260	Vessel V-450	Light Liquid	Aqueous	Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04	2.6504E-03	1.0194E-05
					Mixer	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04		
					Valves	29	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	33	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	27	1	1.8300E-03	5.0833E-04	0.11	5.8255E-05		
		Vessel V-451	Light Liquid		Pumps	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	12	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	7	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	27	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
		Vessel V-454	Light Liquid		Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04		
					Mixer	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04		
					Valves	29	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	33	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	27	1	1.8300E-03	5.0833E-04	0.11	5.8255E-05		
		Vessel V-452	Light Liquid	Organic	Pumps	0	0	1.9900E-02	5.5278E-03	0.84	0.0000E+00	9.2646E-03	3.5633E-05
					Mixer	0	0	1.9900E-02	5.5278E-03	0.84	0.0000E+00		
					Valves	6	0	4.0300E-03	1.1194E-03	0.84	0.0000E+00		
					Connectors	6	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
					Flanges	26	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
		Vessel V-453	Light Liquid		Pumps	2	1	1.9900E-02	5.5278E-03	0.84	4.6323E-03		
					Mixer	1	1	1.9900E-02	5.5278E-03	0.84	4.6323E-03		
					Valves	34	0	4.0300E-03	1.1194E-03	0.84	0.0000E+00		
					Connectors	34	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		
					Flanges	100	0	1.8300E-03	5.0833E-04	0.84	0.0000E+00		

Table 2-14
Area Source Equipment Leak Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Source ID	Source Area (m^2)	Related HW Management Unit	Type of Waste Stream In Service	Waste Stream	Equipment/ Fitting Type	Number of Each Equipment Type Per Waste Stream (1)	Number of Components with detected emissions during 2005 (2)	Equipment Emission Factors (3)		Total VOC Weight Fraction (4)	Total VOC Emissions Rate by Equipment (g/sec)	Total Fugitive Emission Rate (g/sec)	Total Fugitive Emission Rate (g/sec-m^2)
								(kg/hr)	(g/sec)				
AREA3	30	Vessel V-436	Light Liquid	Aqueous	Pumps	1	1	1.9900E-02	5.5278E-03	0.11	6.3348E-04	6.3348E-04	2.1116E-05
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	18	0	4.0300E-03	1.1194E-03	0.11	0.0000E+00		
					Connectors	5	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	54	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
AREA4	30	Vessel V-604	Light Liquid	Aqueous	Pumps	1	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00	1.2829E-04	4.2763E-06
					Mixer	0	0	1.9900E-02	5.5278E-03	0.11	0.0000E+00		
					Valves	11	1	4.0300E-03	1.1194E-03	0.11	1.2829E-04		
					Connectors	6	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		
					Flanges	20	0	1.8300E-03	5.0833E-04	0.11	0.0000E+00		

Notes:

(1) Number of components is based on information from API Emissions Detection Program for Year 2005. No information provided for V-430, V-436, V-454. V-430 and V-436 have been considered similar to V-408. V-454 has been considered similar to V-450.

(2) Based on API Emissions Detection Program for Year 2005

(3) From EPA Protocol for Equipment Leak Emission Estimates, November 1995, Tables 2-1, p 2-12. Emissions from mixers are considered equal to pumps. Emissions from flanges are considered equal to connectors.

(4) Estimated from waste composition by weight.

.ole 2-15
Area Sources Speciated Fugitive Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico
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Fugitive Emission Source	Area (m^2)	Total Fugitive Emission Rate (g/sec)		Waste Stream Composition	Weight Fraction of Each VOC in Waste Stream (%)		Speciated Fugitive Emissions (g/sec)	Speciated Fugitive Emissions (g/sec-m^2)
		Aqueous Waste	Organic Waste		Aqueous Waste	Organic Waste		
Area 1	840	1.2468E-02	1.0440E-02	Methylene chloride	3.00	6.00	1.0004E-03	1.1910E-06
				n-Butanol alcohol	1.30	12.00	1.4148E-03	1.6843E-06
				IPA	3.70	33.00	3.9064E-03	4.6504E-06
				Ethyl acetate	2.70	24.00	2.8421E-03	3.3835E-06
				Toluene	0.38	2.00	2.5617E-04	3.0496E-07
				Ethanol	0.38	3.10	3.7100E-04	4.4167E-07
				Acetone	0.00	0.70	7.3077E-05	8.6996E-08
				Methanol	0.00	0.50	5.2198E-05	6.2140E-08
				Chloroform	0.00	0.50	5.2198E-05	6.2140E-08
				Xylenes	0.00	0.50	5.2198E-05	6.2140E-08
				Cyclohexane	0.00	0.50	5.2198E-05	6.2140E-08
				Cyclohexanone	0.00	0.50	5.2198E-05	6.2140E-08
				Ethyl ether	0.00	0.50	5.2198E-05	6.2140E-08
Area 2	260	2.6504E-03	9.2646E-03	Methylene chloride	3.00	6.00	6.3539E-04	2.4438E-06
				n-Butanol alcohol	1.30	12.00	1.1462E-03	4.4085E-06
				IPA	3.70	33.00	3.1554E-03	1.2136E-05
				Ethyl acetate	2.70	24.00	2.2951E-03	8.8271E-06
				Toluene	0.38	2.00	1.9536E-04	7.5140E-07
				Ethanol	0.38	3.10	2.9727E-04	1.1434E-06
				Acetone	0.00	0.70	6.4852E-05	2.4943E-07
				Methanol	0.00	0.50	4.6323E-05	1.7816E-07
				Chloroform	0.00	0.50	4.6323E-05	1.7816E-07
				Xylenes	0.00	0.50	4.6323E-05	1.7816E-07
				Cyclohexane	0.00	0.50	4.6323E-05	1.7816E-07
				Cyclohexanone	0.00	0.50	4.6323E-05	1.7816E-07
				Ethyl ether	0.00	0.50	4.6323E-05	1.7816E-07

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Area Sources Speciated Fugitive Emission Rates
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico
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Fugitive Emission Source	Area (m^2)	Total Fugitive Emission Rate (g/sec)		Waste Stream Composition	Weight Fraction of Each VOC in Waste Stream (%)		Speciated Fugitive Emissions (g/sec)	Speciated Fugitive Emissions (g/sec-m^2)
		Aqueous Waste	Organic Waste		Aqueous Waste	Organic Waste		
Area 3	30	6.3348E-04	0.0000E+00	Methylene chloride	3.00	6.00	1.9005E-05	6.3348E-07
				n-Butanol alcohol	1.30	12.00	8.2353E-06	2.7451E-07
				IPA	3.70	33.00	2.3439E-05	7.8130E-07
				Ethyl acetate	2.70	24.00	1.7104E-05	5.7014E-07
				Toluene	0.38	2.00	2.4072E-06	8.0241E-08
				Ethanol	0.38	3.10	2.4072E-06	8.0241E-08
				Acetone	0.00	0.70	0.0000E+00	0.0000E+00
				Methanol	0.00	0.50	0.0000E+00	0.0000E+00
				Chloroform	0.00	0.50	0.0000E+00	0.0000E+00
				Xylenes	0.00	0.50	0.0000E+00	0.0000E+00
				Cyclohexane	0.00	0.50	0.0000E+00	0.0000E+00
				Cyclohexanone	0.00	0.50	0.0000E+00	0.0000E+00
				Ethyl ether	0.00	0.50	0.0000E+00	0.0000E+00
Area 4	30	1.2829E-04	0.0000E+00	Methylene chloride	3.00	6.00	3.8487E-06	1.2829E-07
				n-Butanol alcohol	1.30	12.00	1.6677E-06	5.5592E-08
				IPA	3.70	33.00	4.7467E-06	1.5822E-07
				Ethyl acetate	2.70	24.00	3.4638E-06	1.1546E-07
				Toluene	0.38	2.00	4.8750E-07	1.6250E-08
				Ethanol	0.38	3.10	4.8750E-07	1.6250E-08
				Acetone	0.00	0.70	0.0000E+00	0.0000E+00
				Methanol	0.00	0.50	0.0000E+00	0.0000E+00
				Chloroform	0.00	0.50	0.0000E+00	0.0000E+00
				Xylenes	0.00	0.50	0.0000E+00	0.0000E+00
				Cyclohexane	0.00	0.50	0.0000E+00	0.0000E+00
				Cyclohexanone	0.00	0.50	0.0000E+00	0.0000E+00
				Ethyl ether	0.00	0.50	0.0000E+00	0.0000E+00

Table 3-1
Gas and Particle Data
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Particle Phase and Particle-Bound Phase Data[1]								Vapor Phase Data[2]		Mercury Vapor Phase Data[2]		Dry Vapor Deposition Velocity [4]	
Mean Particle Diameter (um)	Particle Radius (um)	Surface Area/Volume (um^{-1})	Fraction of Total Mass	Portion Available Surface Area	Fraction of Total Surface Area	Wet Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Frozen [3] Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Wet Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Frozen [3] Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Wet Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Frozen [3] Scavenging Coefficient ($s^{-1}/mm\text{-}h^{-1}$)	Organic Contaminants, chlorine, and HCL (m/s)	Divalent Mercury (m/s)
>15.82	7.91	0.379	0.2	0.0759	0.0815	6.7E-04	2.2E-04						
12.49	6.245	0.48	0.1	0.0480	0.0516	6.7E-04	2.2E-04						
10.72	5.36	0.56	0.1	0.0560	0.0601	6.0E-04	2.0E-04						
8.96	4.48	0.67	0.1	0.0670	0.072	5.2E-04	1.7E-04						
7.28	3.64	0.824	0.1	0.0824	0.0886	4.5E-04	1.5E-04	1.6E-04	5.3E-05	1.6E-04	5.3E-05	5.0E-03	2.9E-02
6.02	3.01	0.997	0.1	0.0997	0.1071	4.2E-04	1.4E-04						
4.875	2.438	1.231	0.1	0.1231	0.1323	3.5E-04	1.2E-04						
3.975	1.988	1.509	0.1	0.1509	0.1622	2.6E-04	8.7E-05						
2.635	1.318	2.277	0.1	0.2277	0.2447	2.0E-04	6.7E-05						
		Sum	1.0	0.9307	1.00								

Notes:

(1) Obtained from preliminary risk assessment, which is based on stack test results performed on October 1980. Particle density used for all sizes was 1.9 gm/cm^3.

(2) Wet scavenging coefficient has been estimated based on a scavenging coefficient for a 0.1-um particle as per HHRAP recommendation on page 3-50.

(3) Although frozen scavenging coefficient is not applicable to the site under evaluation, ISCST3 requires an input value for this parameter. The frozen scavenging coefficient has been approximated as 1/3 of the the wet scavenging coefficient as per HHRAP recommendation on page 3-50.

(4) Dry vapor deposition velocities are obtained from HHRAP recommended values on page 3-42.

Table 3-2
Facility Building Characteristics
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

ISCST3 Building ID	Building Description	Building Type	Building Base Elevation (m) (see note 1)	Building Height (m) (see note 2)	Building Corners UTM Coordinates (m) (see note 3)							
					Corner 01		Corner 02		Corner 03		Corner 04	
					X	Y	X	Y	X	Y	X	Y
BLD-1	Process Building G-I	Rectangular	7	13.11	801407	1986943	801406	1986926	801453	1986922	801455	1986939
BLD-2	Process Building G-II	Rectangular	7	13.11	801402	1986885	801404	1986901	801452	1986897	801451	1986881
BLD-3	Process Building G-III	Rectangular	7	18.59	801419	1986983	801418	1986967	801455	1986964	801456	1986980

Notes:
(1) Base elevation was obtained from NAD27 digital elevation model files (DEM).
(2) Building heights determined from on-site measurements.
(3) Building corners determined using NAD 27 UTM coordinate overlay maps.

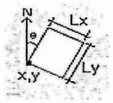
Table 3-3
Point Source and Area Source Operating Parameters
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Source ID	Source Type	UTM Coordinates		Base Elevation (m)[1]	Release Height Above Ground (m)[2]	Gas Exit Temperature (°K)	Gas Exit Velocity (m/s)	Inside Diameter at Release Point (m)	Lx Length of the X Side of the Area (m)	Ly Length of the Y Side of the Area (m)	Q Orientation Angle from North (deg)	Area (m^2)
		X (m)	Y (m)									
STACK	Point	801477	1986905	7	22.86	353	9.7	0.61	---	---	---	---
SCRUBBER (3)	Point	801476	1986914	7	10.38	322	7.0	0.51	---	---	---	---
AREA1	Area	801456	1986893	7	1.8	---	---	---	24	35	4.47	840
AREA2	Area	801487	1986864	7	3.7	---	---	---	13	20	4.47	260
AREA3	Area	801455	1986874	7	3.7	---	---	---	5	6	4.47	30
AREA4	Area	801476	1986957	7	3.7	---	---	---	5	6	4.47	30

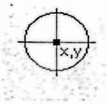
Notes
(1) Base elevation was obtained from NAD27 digital elevation model files.
(2) For area sources the release height is equal to 1/2 of the vertical extend of fugitive emissions. The height of the vessels inside the area has been considered as a vertical extend of fugitive emissions (see HHRAP page 3-64).

(3) The gas exit temperature, gas exit velocity, and inside diameter at release point were obtained from the scrubber engineering design blueprint.

Reference Diagram



Area Source



Point Source

Table 3-4
ISC-AERMOD Input Control Pathway Parameters
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Item	Control Pathway					
	Input	Settings/Assumptions				References
		Particle Phase	Particle Bound	Vapor Phase	Mercury Vapor Phase	
1	Model Option	DFAULT	DFAULT	TOXICS	TOXICS	HHRAP page 3-41
2	Output Parameters	CONC DDEP WDEP DEPOS DRYDPLT WETDPL	CONC DDEP WDEP DEPOS DRYDPLT WETDPL	CONC DDEP WDEP DEPOS DRYDPLT WETDPL	CONC DDEP WDEP DEPOS DRYDPLT WETDPL	HHRAP page 3-41
3	Terrain type	RURAL	RURAL	RURAL	RURAL	HHRAP page 3-41
4	Terrain Heights	ELEVATED	ELEVATED	ELEVATED	ELEVATED	HHRAP page 3-45
5	Terrain Calculation Algorithm	COMPLEX	COMPLEX	COMPLEX	COMPLEX	HHRAP page 3-15
6	Gas Deposition Velocity (m/s)	Not required	Not required	0.005	0.029	HHRAP page 3-42
7	Average Time Acute Risk	highest 1-hour average	highest 1-hour average	highest 1-hour average	highest 1-hour average	HHRAP page 3-67
8	Average Time Chronic Risk	ANNUAL	ANNUAL	ANNUAL	ANNUAL	HHRAP page 3-44

.ble 4-1
Selection of Exposure Scenarios and Pathways
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Exposure Pathways	Selected Exposure Scenarios						
	Farmer	Farmer Child	Resident	Resident Child	Fisher	Fisher Child	Acute Receptor
Inhalation of vapor and particulates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incidental ingestion of soil	Yes	Yes	Yes	Yes	Yes	Yes	--
Ingestion of drinking water from surface water sources	--	--	--	--	--	--	--
Ingestion of homegrown produce	Yes	Yes	Yes	Yes	Yes	Yes	--
Ingestion of homegrown beef	Yes	Yes	--	--	--	--	--
Ingestion of milk from homegrown cows	Yes	Yes	--	--	--	--	--
Ingestion of homegrown chicken	Yes	Yes	--	--	--	--	--
Ingestion of eggs from homegrown chicken	Yes	Yes	--	--	--	--	--
Ingestion of homegrown pork	Yes	Yes	--	--	--	--	--
Ingestion of fish	--	--	--	--	Yes	Yes	--
Ingestion of breast milk	Yes	--	Yes	--	Yes	--	--

Note:
-- Pathway not included in Risk Assessment as per HHRAP guidance.

COPC NAME	CAS_NUMBER	Molecular weight	Melting Point	Vapor pressure at 25°C	Solubility in water	Henry's Law constant
(Symbol)		MW	Tm	Vp	S	H
(Units)		g/mol	K	atm	mg/L-water	atm-m3/mol
Acetaldehyde	75-07-0	44.05	150.15	1.19	1000000	0.0000789
Acetone	67-64-1	58.08	178.15	0.303	1000000	0.000039
Antimony	7440-36-0	124.77	903.15	0.9	23000	0.025
Aroclor 1016	12674-11-2	257.9	0	0.000000526	0.42	0.000271
Aroclor 1254	11097-69-1	326.44	283.1	0.000000101	0.043	0.000283
Arsenic	7440-38-2	77.95	1093.15	3.3E-12	34700	0.77
Barium	7440-39-3	139.36	1003.15	5.58E-12	54800	0
Beryllium	7440-41-7	9.01	1573.15	5.58E-12	149000	0.015
Cadmium	7440-43-9	112.4	593.15	5.45E-12	123000	0.031
Chloroform (Trichloromethane)	67-66-3	119.37	209.15	0.263	7900	0.0037
Chromium	7440-47-3	51.996	2173.15	5.58E-12	86700	0
Chromium, hexavalent	18540-29-9	0	2173.15	0	0	0
Coplanar PCBs	1336-36-3	326.44	283.1	0.000000101	0.043	0.000283
Fluoranthene	206-44-0	202.256	383.15	1.03E-08	0.21	0.000016
Formaldehyde	50-00-0	30.03	181.15	6.89	550000	0.000000336
HeptaCDD, 1,2,3,4,6,7,8-	35822-46-9	425.31	537.7	7.37E-15	0.0000024	0.000012
HeptaCDF, 1,2,3,4,6,7,8-	67562-39-4	409.31	509.7	4.61E-14	0.00000135	0.0000141
HeptaCDF, 1,2,3,4,7,8,9-	55673-89-7	409.31	495.2	4.04E-13	0.0000014	0.000014
HexaCDD, 1,2,3,4,7,8-	39227-28-6	390.87	547.2	5E-14	0.00000442	0.0000107
HexaCDD, 1,2,3,6,7,8-	57653-85-7	390.87	558.7	4.73E-14	0.0000044	0.000011
HexaCDD, 1,2,3,7,8,9-	19408-74-3	390.87	516.7	6.45E-14	0.0000044	0.000011
HexaCDF, 1,2,3,4,7,8-	70648-26-9	374.87	499.2	3.16E-13	0.00000825	0.0000143
HexaCDF, 1,2,3,6,7,8-	57117-44-9	374.87	505.7	2.89E-13	0.0000177	0.00000731
HexaCDF, 1,2,3,7,8,9-	72918-21-9	374.87	520.7	3.68E-13	0.000013	0.000011
HexaCDF, 2,3,4,6,7,8-	60851-34-5	374.87	512.7	2.63E-13	0.000013	0.000011
Lead	7439-92-1	209.21	603.15	3.97E-12	9580	0.025
Mercuric chloride	7487-94-7	271.52	550.1	0.00012	69000	7.1E-10
Mercury	7439-97-6	200.59	234.23	0.00000263	0.06	0.0071
Methanol	67-56-1	32.042	175.47	0.166	1000000	0.00000455
Methyl mercury	22967-92-6	216	0	0	0	0.00000047
Methylene chloride	75-09-2	84.93	178.15	0.566	13000	0.0022
Nickel	7440-02-0	58.71	1773.15	5.58E-12	422000	0.025
OctaCDD, 1,2,3,4,6,7,8,9-	3268-87-9	460.76	598.7	1.09E-15	0.000000074	0.00000675
OctaCDF, 1,2,3,4,6,7,8,9-	39001-02-0	444.76	532.2	4.93E-15	0.00000116	0.00000188
PentaCDD, 1,2,3,7,8-	40321-76-4	356.42	513.7	5.79E-13	0.000118	0.0000026
PentaCDF, 1,2,3,7,8-	57117-41-6	340.42	499.2	2.23E-12	0.00024	0.000005
PentaCDF, 2,3,4,7,8-	57117-31-4	340.42	469.4	3.42E-12	0.000236	0.00000498
Propionaldehyde	123-38-6	58.08	193	0.417	306000	0.0000734
Pyrene	129-00-0	202.256	423.15	6.05E-09	1.4	0.000011
Selenium	7782-49-2	78.96	493.15	1.87E-13	2060	0.0097
Silver	7440-22-4	107.87	1233.15	5.58E-12	70500	0
TetraCDD, 2,3,7,8-	1746-01-6	321.98	578.7	1.97E-12	0.0000193	0.0000329
TetraCDF, 2,3,7,8-	51207-31-9	305.98	500.7	1.97E-11	0.000419	0.0000144
Thallium	7440-28-0	205.38	573.15	5.58E-12	26500	0
Toluene	108-88-3	92.141	178.15	0.0368	530	0.0066
Xylene, m- (1)	108-38-3	106.17	225.15	0.0112	160	0.0073
Zinc	7440-66-6	65.37	693.15	5.09E-12	344000	0.025

Notes:

1. m-xylene was used to evaluate total xylenes since toxicity values are based predominantly on this isomer.

iffusivity of COPC in air	Diffusivity of COPC in water	Octanol-water partition coefficient	Organic carbon-water partition coefficient	Soil-water partition coefficient	Suspended sediment-surface water partition coefficient	Bed sediment/sediment pore-water partition coefficient	COPC soil loss constant due to biotic and abiotic degradation
Da	Dw	Kow	Koc	Kds	Kdsw	Kdbs	Ksg
cm^2/s	cm^2/s	unitless	mL/g	cm^3/g	L/kg	cm3/g/kg	1/yr
0.124	0.0000141	0.602559586	0.61	0.006	0.05	0.02	0
0.124	0.0000114	0.575439937	0.58	0.087	0.04	0.02	36.14
0.0772	0.00000957	5.370317964	0	45	45	45	0
0.001	0.00001	489779	392238	3922	29418	15690	0.03
0.001	0.00001	3162278	2453466	24535	184010	98139	0.03
0.0772	0.00000957	4.786300923	0	29	29	29	0
0.0772	0.00000957	1.698243652	0	41	41	41	0
0.0772	0.00000957	0.26915348	0	790	790	790	0
0.0772	0.00000957	0.851138038	0	75	75	75	0
0.104	0.00001	100	52.5	0.08	3.94	2.1	1.41
0.1265	0.0000141	1.698243652	0	19	19	19	0
0	0	1	0	19	19	19	0
0.001	0.00001	3162278	2453466	24535	184010	98139	0.03
0.001	0.00001	100000	49100	11000	3683	1964	0.57
0.178	0.0000198	2.238721139	2.21	0.02	0.17	0.09	36.14
090488834	0.000008	100000000	61659500	616595	4624463	2466380	0.03
020318339	0.000008	25118864	15488166	154882	1161612	619527	0.03
020318339	0.000008	25118864	15488166	154882	1161612	619527	0.03
094391224	0.000008	63095734	38904515	389045	2917839	1556181	0.03
094391224	0.000008	19952623	12302688	123027	922702	492108	0.03
094391224	0.000008	19952623	12302688	123027	922702	492108	0.03
021231175	0.000008	10000000	6165950	61660	462446	246638	0.03
021231175	0.000008	10000000	6165950	61660	462446	246638	0.03
021231175	0.000008	10000000	6165950	61660	462446	246638	0.03
021231175	0.000008	10000000	6165950	61660	462446	246638	0.03
0.0772	0.00000957	5.370317964	0	900	900	900	0
045312607	5.24672E-06	0.609536897	0	58000	100000	50000	0
0.0109	0.0000301	4.168693835	0	1000	1000	3000	0
0.15	0.0000164	0.169824365	0.18	0.002	0.01	0.007	36.14
052777778	6.11111E-06	0	0	7000	100000	3000	0
0.101	0.0000117	19.95262315	10	0.024	0.75	0.4	9.03
0.0772	0.00000957	0.26915348	0	65	65	65	0
086938152	0.000008	158489319	97723722	977237	7329279	3908949	0.03
019491781	0.000008	100000000	61659500	616595	4624463	2466380	0.03
98847742	0.000008	4365158	2691535	26915	201865	107661	0.03
22279572	0.000008	6165950	3801894	38019	285142	152076	0.03
22279572	0.000008	3162278	1949845	19498	146238	77994	0.03
0.1267	0.1267	3.89	4	0.04	0.3	0.16	0
0.001	0.00001	79433	68000	9500	5100	2720	0.13
0.0772	0.00000957	1.737800829	0	5	5	5	0
0.0772	0.00000957	1.698243652	0	8.3	8.3	8.3	0
0.104	0.0000056	6309573	3890451	38905	291784	155618	0.03
0.0235	0.00000601	1258925	776247	7762	58219	31050	0.03
0.0772	0.00000957	1.698243652	0	71	71	71	0
0.087	0.0000086	501.1872336	140	0.36	10.5	5.6	11.5
0.07	0.0000078	1585	196	0.81	14.7	7.84	9.03
0.0772	0.00000957	0.338844156	0	62	62	62	0

COPC NAME	Fraction in vapor phase	Root concentration factor	Plant-soil bioconcentration factor for below-ground plants	Plant-soil bioconcentration factor for above-ground plants	Plant-soil bioconcentration factor for forage/silage	COPC air-to-plant biotransfer factor, above-ground plants
(Symbol)	Fv	RCF	brroot	Brag	Brf/s	Bvag
(Units)	unitless	(ug/g)/(ug/mL)	unitless	unitless	unitless	(mg/kg)/mg/kg)
Acetaldehyde	1	6.46	1063	8.38	8.38	0.000413
Acetone	1	6.46	74.2	8.38	8.38	0.000796
Antimony	1	0	0.03	0.0319	0.2	0
Aroclor 1016	0.999	5589	1.42	0.0199	0.0199	237
Aroclor 1254	0.992	23499	0.958	0.00678	0.00678	1652
Arsenic	0.006	0	0.008	0.00633	0.036	0
Barium	0.009	0	0.015	0.0322	0.15	0
Beryllium	0.009	0	0.0015	0.00258	0.01	0
Cadmium	0.009	0	0.064	0.125	0.364	0
Chloroform (Trichloromethane)	1	8.05	101	2.7	2.7	0.00204
Chromium	0.009	0	0.0045	0.00488	0.0075	0
Chromium, hexavalent	0	0	0.0045	0.00488	0.0075	0
Coplanar PCBs	0.992	23499	0.958	0.00678	0.00678	1652
Fluoranthene	0.992	1644	0.15	0.0499	0.0499	738
Formaldehyde	1	6.74	305	8.38	8.38	0.392
HeptaCDD, 1,2,3,4,6,7,8-	0.003	335781	0.545	0.00092	0.00092	910000
HeptaCDF, 1,2,3,4,6,7,8-	0.01	115892	0.748	0.00205	0.00205	830000
HeptaCDF, 1,2,3,4,7,8,9-	0.057	115892	0.748	0.00205	0.00205	830000
HexaCDD, 1,2,3,4,7,8-	0.024	235535	0.605	0.0012	0.0012	520000
HexaCDD, 1,2,3,6,7,8-	0.029	97063	0.789	0.00234	0.00233	520000
HexaCDD, 1,2,3,7,8,9-	0.016	97063	0.789	0.00234	0.00234	520000
HexaCDF, 1,2,3,4,7,8-	0.049	57023	0.925	0.00348	0.00348	162000
HexaCDF, 1,2,3,6,7,8-	0.052	57023	0.925	0.00348	0.00348	162000
HexaCDF, 1,2,3,7,8,9-	0.09	57023	0.925	0.00348	0.00348	162000
HexaCDF, 2,3,4,6,7,8-	0.055	57023	0.925	0.00348	0.00348	162000
Lead	0.007	0	0.009	0.0136	0.045	0
Mercuric chloride	0.85	0	0.036	0.0145	0	1800
Mercury	1	0	0	0	0	0
Methanol	1	6.39	3649	8.38	8.38	0.00186
Methyl mercury	0	0	0.099	0.0294	0	0
Methylene chloride	1	8.64	359	6.86	6.86	0.000616
Nickel	0.009	0	0.008	0.00931	0.032	0
OctaCDD, 1,2,3,4,6,7,8,9-	0.002	478692	0.49	0.000705	0.000705	2360000
OctaCDF, 1,2,3,4,6,7,8,9-	0.002	478692	0.776	0.00092	0.00092	2280000
PentaCDD, 1,2,3,7,8-	0.117	30120	1.12	0.00562	0.00562	239000
PentaCDF, 1,2,3,7,8-	0.268	39296	1.03	0.00461	0.00461	97500
PentaCDF, 2,3,4,7,8-	0.221	23499	1.21	0.00678	0.00678	97500
Propionaldehyde	1	1.04	26	8.4	8.4	0.00323598
Pyrene	0.994	1377	0.145	0.057	0.057	840
Selenium	0	0	0.022	0.0195	0.016	0
Silver	0.009	0	0.1	0.138	0.4	0
TetraCDD, 2,3,7,8-	0.664	39999	1.03	0.00455	0.00455	65500
TetraCDF, 2,3,7,8-	0.77	11562	1.49	0.0115	0.0115	45700
Thallium	0.009	0	0.0004	0.000858	0.004	0
Toluene	1	27.9	77.4	1.07	1.07	0.00636
Xylene, m- (1)	1	67.6	83.5	0.548	0.548	0.0196
Zinc	0.008	0	0.9	0.097	0.25	0

Notes:

1. m-xylene was used to evaluate total xylenes since toxicity values are based predominantly on this isomer.

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C air-to-biotransfer or-forage	Biotransfer factor-milk	Biotransfer factor-beef	Biotransfer factor-pork	Bioconcentration factor in fish	Bioaccumulation factor for COPC in fish	Biota-sediment accumulation factor	Plant-soil biocontration factor for grain
forage	Bamilk	Babeef	Bapork	BCFfish	BAF	BSAFfish	brgrain
g)/mg/kg)	day/kg	day/kg	day/kg	L/kgFW	L/kg	(mg/kg)/mg/kg)	unitless
00413	6.33678E-06	3.00997E-05	3.64365E-05	3.16	0	0	8.38
00796	6.01946E-06	2.85924E-05	3.46119E-05	3.16	0	0	8.38
0	0.0001	0.001	0	40	0	0	0.03
237	0.008416395	0.039977875	0.048394269	20000	0	2	0.0199
1652	0.006520937	0.03097445	0.037495387	84100	0	2	0.00678
0	0.00006	0.002	0	114	0	0	0.004
0	0.00035	0.00015	0	633	0	0	0.015
0	0.0000009	0.001	0	62	0	0	0.0015
0	0.0000065	0.00012	0.000191489	907	0	0	0.062
00204	0.000611026	0.002902376	0.003513402	6.92	0	0	2.7
0	0.0015	0.0055	0	19	0	0	0.0045
0	0.0015	0.0055	0	3.16	0	0	0.0045
652	0.006521	0.030974	0.037495	84100	0	2	0.00678
738	0.008261521	0.039242223	0.047503744	1410	4493	0	0.0499
.392	2.53765E-05	0.000120539	0.000145915	3.16	0	0	8.38
0000	0.00184527	0.008765034	0.010610304	2754	0	0.005	0.00092
0000	0.00345796	0.016425311	0.019883271	18281	0	0.005	0.00205
0000	0.00345796	0.016425311	0.019883271	18281	0	0.005	0.00205
0000	0.002316861	0.01100509	0.013321951	5176	0	0.04	0.0012
0000	0.003778766	0.017949138	0.021727904	25100	0	0.04	0.00234
0000	0.003778766	0.017949138	0.021727904	25100	0	0.04	0.00234
2000	0.004797997	0.022790487	0.027588484	48977	0	0.04	0.00348
2000	0.004797997	0.022790487	0.027588484	48977	0	0.04	0.00348
2000	0.004797997	0.022790487	0.027588484	48977	0	0.04	0.00348
2000	0.004797997	0.022790487	0.027588484	48977	0	0.04	0.00348
0	0.00025	0.0003	0	0.09	0	0	0.009
300	0.002262	0.00522	0.00003393	0	0	0	0.0093
0	0	0	0	0	0	0	0
0186	1.90862E-06	9.06593E-06	1.09746E-05	3.16	0	0	8.38
0	0.000338	0.00078	0.00000507	0	6800000	0	0.019
0616	0.000184395	0.000875878	0.001060273	2	0	0	6.86
0	0.001	0.006	0	78	0	0	0.006
0000	0.001443112	0.006854781	0.008297893	1465	0	0.0001	0.000705
0000	0.00184527	0.008765034	0.010610304	2754	0	0.0001	0.00092
000	0.006053264	0.028753002	0.034806266	25870	0	0.09	0.00562
500	0.00553419	0.026287404	0.031821594	33752	0	0.09	0.00461
500	0.006520937	0.03097445	0.037495387	20183	0	0.09	0.00678
23598	4.35362E-05	0.000206797	0.000250333	0.56788604	0	0	8.4
40	0.008092263	0.038438249	0.046530513	1180	3289	0	0.057
)	0.0058565	0.002265	0.187659574	129	0	0	0.002
)	0.02	0.003	0	87.7	0	0	0.1
500	0.005499206	0.026121229	0.031620435	34400	0	0.09	0.00455
700	0.007678387	0.036472338	0.044150725	9931	0	0.09	0.0115
)	0.002	0.04	0	10000	0	0	0.0004
636	0.001619385	0.007692077	0.009311461	23.9	0	0	1.07
196	0.002833348	0.013458405	0.016291754	58.1	0	0	0.548
)	0.0000325	0.00009	0.00012766	2059	0	0	0.054

COPC NAME	Biotransfer factor-eggs	Biotransfer factor-poultry	Soil bioavailability factor	Soil enrichment ratio	Wet deposition fraction adhering to plant surface	Empirical correction factor Metabolism factor
(Symbol)	Baeggs	Bapoult	Bs	ER	Fw	MF
(Units)	day/kg	day/kg	unitless	unitless	unitless	unitless
Acetaldehyde	1.26736E-05	2.21787E-05	1	3	0.6	1
Acetone	1.20389E-05	2.10681E-05	1	3	0.6	1
Antimony	0	0	1	1	0.2	1
Aroclor 1016	0.016832789	0.029457381	1	3	0.6	1
Aroclor 1254	0.013041874	0.022823279	1	3	0.6	1
Arsenic	0	0	1	1	0.2	1
Barium	0	0	1	1	0.2	1
Beryllium	0	0	1	1	0.2	1
Cadmium	0.0025	0.10625	1	1	0.2	1
Chloroform (Trichloromethane)	0.001222053	0.002138592	1	3	0.6	1
Chromium	0	0	1	1	0.2	1
Chromium, hexavalent	0	0				
Coplanar PCBs	0.013042	0.02282	1	3	0.6	1
Fluoranthene	0.016523041	0.028915322	1	3	0.6	1
Formaldehyde	5.07531E-05	8.88179E-05	1	3	0.6	1
HeptaCDD, 1,2,3,4,6,7,8-	0.003690541	0.006458446	1	3	0.6	1
HeptaCDF, 1,2,3,4,6,7,8-	0.00691592	0.012102861	1	3	0.6	1
HeptaCDF, 1,2,3,4,7,8,9-	0.00691592	0.012102861	1	3	0.6	1
HexaCDD, 1,2,3,4,7,8-	0.004633722	0.008109014	1	3	0.6	1
HexaCDD, 1,2,3,6,7,8-	0.007557532	0.013225681	1	3	0.6	1
HexaCDD, 1,2,3,7,8,9-	0.007557532	0.013225681	1	3	0.6	1
HexaCDF, 1,2,3,4,7,8-	0.009595994	0.01679299	1	3	0.6	1
HexaCDF, 1,2,3,6,7,8-	0.009595994	0.01679299	1	3	0.6	1
HexaCDF, 1,2,3,7,8,9-	0.009595994	0.01679299	1	3	0.6	1
HexaCDF, 2,3,4,6,7,8-	0.009595994	0.01679299	1	3	0.6	1
Lead	0	0	1	1	0.2	1
Mercuric chloride	0.023925	0.023925	1	1	0.6	1
Mercury	0	0	1	1	0.2	1
Methanol	3.81723E-06	6.68016E-06	1	3	0.6	1
Methyl mercury	0.003575	0.003575	1	3	0.6	1
Methylene chloride	0.000368791	0.000645384	1	3	0.6	1
Nickel	0	0	1	1	0.2	1
OctaCDD, 1,2,3,4,6,7,8,9-	0.002886224	0.005050891	1	3	0.6	1
OctaCDF, 1,2,3,4,6,7,8,9-	0.003690541	0.006458446	1	3	0.6	1
PentaCDD, 1,2,3,7,8-	0.012106527	0.021186423	1	3	0.6	1
PentaCDF, 1,2,3,7,8-	0.011068381	0.019369666	1	3	0.6	1
PentaCDF, 2,3,4,7,8-	0.013041874	0.022823279	1	3	0.6	1
Propionaldehyde	8.70723E-05	0.000152377	1	3	0.6	1
Pyrene	0.016184526	0.028322921	1	3	0.6	1
Selenium	1.12625	1.12625	1	1	0.2	1
Silver	0	0	1	1	0.2	1
TetraCDD, 2,3,7,8-	0.010998412	0.019247221	1	3	0.6	1
TetraCDF, 2,3,7,8-	0.015356774	0.026874354	1	3	0.6	1
Thallium	0	0	1	1	0.2	1
Toluene	0.003238769	0.005667846	1	3	0.6	1
Xylene, m- (1)	0.005666697	0.00991672	1	3	0.6	1
Zinc	0.00875	0.00875	1	1	0.2	1

Notes:
1. m-xylene was used to evaluate total xylenes since toxicity values are based predominantly on this isomer.

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npirical ction factor veground roduce	Empirical correction factor Forage	Empirical correction factor Silage	Empirical correction factor Belowground Produce
VG_{ag}	VG_{ag}	VG_{ag}	$VG_{rootveg}$
nitless	unitless	unitless	unitless
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
0.01	1	0.5	0.01
0.1	1	0.5	0.01
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
0.01	1	0.5	0.01
0.01	1	0.5	0.01
1	1	0.5	1
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
0.01	1	0.5	0.01
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
1	1	0.5	1
.01	1	0.5	0.01
.01	1	0.5	0.01
.01	1	0.5	0.01
01	1	0.5	0.01
01	1	0.5	0.01
1	1	0.5	1
01	1	0.5	0.01
1	1	0.5	1
1	1	0.5	1
01	1	0.5	0.01
01	1	0.5	0.01
l	1	0.5	1
l	1	0.5	1
.	1	0.5	1
:	1	0.5	1

Table 5-2
Site Specific Exposure Parameters Using HHRAP Default Values
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico
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Site Parameter	Units	Value	Symbol
Soil dry bulk density	g/cm^3	1.5	bd
Forage fraction grown on contam. soil eaten by CATTLE	--	1	beef_fi_forage
Grain fraction grown on contam. soil eaten by CATTLE	--	1	beef_fi_grain
Silage fraction grown on contam. eaten by CATTLE	--	1	beef_fi_silage
Qty of forage eaten by CATTLE each day	kg DW/day	8.8	beef_qp_forage
Qty of grain eaten by CATTLE each day	kg DW/day	0.47	beef_qp_grain
Qty of silage eaten by CATTLE each day	kg DW/day	2.5	beef_qp_silage
Grain fraction grown on contam. soil eaten by CHICKEN	--	1	chick_fi_grain
Qty of grain eaten by CHICKEN each day	kg DW/day	0.2	chick_qp_grain
Fish lipid content	--	0.07	f_lipid
Fraction of CHICKEN's diet that is soil	--	0.1	fd_chicken
Universal gas constant	$atm\text{-}m^3/mol\text{-}K$	8.21E-05	gas_r
Plant surface loss coefficient	yr^{-1}	18	kp
Fraction of mercury emissions NOT lost to the global cycle	--	0.48	merc_q_corr
Fraction of mercury speciated into methyl mercury in produce	--	0.22	mercmethyl_ag
Fraction of mercury speciated into methyl mercury in soil	--	0.02	mercmethyl_sc
Forage fraction grown contam. soil, eaten by MILK CATTLE	--	1	milk_fi_forage
Grain fraction grown contam. soil, eaten by MILK CATTLE	--	1	milk_fi_grain
Silage fraction grown contam. soil, eaten by MILK CATTLE	--	1	milk_fi_silage
Qty of forage eaten by MILK CATTLE each day	kg DW/day	13.2	milk_qp_forage
Qty of grain eaten by MILK CATTLE each day	kg DW/day	3	milk_qp_grain
Qty of silage eaten by MILK CATTLE each day	kg DW/day	4.1	milk_qp_silage
Averaging time	yr	1	milkfat_at
Body weight of infant	kg	9.4	milfat_bw_infant
Exposure duration of infant to breast milk	yr	1	milkfat_ed
Proportion of ingested dioxin that is stored in fat	--	0.9	milkfat_f1
Proportion of mothers weight that is fat	--	0.3	milkfat_f2
Fraction of fat in breast milk	--	0.04	milkfat_f3
Fraction of ingested contaminant that is absorbed	--	0.9	milkfat_f4
Half-life of dioxin in adults	days	2555	milkfat_h
Ingestion rate of breast milk	kg/day	0.688	milkfat_ir_milk
Viscosity of air corresponding to air temp.	g/cm-s	1.81E-04	mu_a
Fraction of grain grown on contam. soil eaten by PIGS	--	1	pork_fi_grain
Fraction of silage grown on contam. soil and eaten by PIGS	--	1	pork_fi_silage
Qty of grain eaten by PIGS each day	kg DW/day	3.3	pork_qp_grain
Qty of silage eaten by PIGS each day	kg DW/day	1.4	pork_qp_silage
Qty of soil eaten by CATTLE	kg/day	0.5	qs_beef
Qty of soil eaten by CHICKEN	kg/day	0.022	qs_chick
Qty of soil eaten by DAIRY CATTLE	kg/day	0.4	qs_milk

Table 5-2
Site Specific Exposure Parameters Using HHRAP Default Values
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico
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Qty of soil eaten by PIGS	kg/day	0.37	qs_pork
Density of air	g/cm^3	1.20E-03	rho_a
Solids particle density	g/cm^3	2.7	rho_s
Interception fraction - edible portion ABOVEGROUND	--	0.39	rp
Interception fraction - edible portion FORAGE	--	0.5	rp_forage
Interception fraction - edible portion SILAGE	--	0.46	rp_silage
Ambient air temperature	K	298	t
Temperature correction factor	--	1.026	theta
Soil volumetric water content	mL/cm^3	0.2	theta_s
Length of plant expos. to depos. - ABOVEGROUND	Yr	0.16	tp
Length of plant expos. to depos. - FORAGE	Yr	0.12	tp_forage
Length of plant expos. to depos. - SILAGE	Yr	0.16	tp_silage
Dry deposition velocity	cm/s	0.5	vdv
Dry deposition velocity for mercury	cm/s	2.9	vdv_hg
Yield/standing crop biomass - edible portion ABOVEGROUND	kg DW/m^2	2.24	yp
Yield/standing crop biomass - edible portion FORAGE	kg DW/m^2	0.24	yp_forage
Yield/standing crop biomass - edible portion SILAGE	kg DW/m^2	0.8	yp_silage

Table 5-3
Site Specific Exposure Parameters Using Site Data
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Variable	Symbol	Units	Value	Rationale	Reference
Precipitation	P	cm/yr	116	Based on annual average precipition for the area estimated from mean annual precipitation data for 1971-2000.	1
Runoff	RO	cm/yr	12.4	Average surface water runoff for USGS gauging stations at Rio Lapa, Rio Majada, Rio Coamo, Rio Descalabrado, Rio Toa Vaca, and Rio Jacaguas (ref. 2) reduced by 50% to account for surface water contributions due to interflow and ground water recharge as per EPA (ref. 3, pg. 7-35). These rivers, which occur in the southeastern part of Puerto Rico, have drainage basins with similar annual precipitation as at the study area.	2, 3
Irrigation	I	cm/yr	3.2	Average of the irrigation application rates for Guayama and Salinas Irrigation Districts (70.1 cm/yr) proportioned according to the percentage of irrigated land within the Guayama and Salinas municipalities (4.5%).	4
Evapotranspiration	Ev	cm/yr	76.3	Evapotranspiration estimated as 64% of precipitation based on Puerto Rico specific reference (ref. 5), plus an estimated 64% of irrigation	5
USLE Cover Management Factor	C	unitless	0.003	From Table 10 of the reference. Assumes either no appreciable canopy or tall weeds/short brush canopy, a 95+ percent ground cover, and cover at surface consisting of grass, grasslike plants, or decaying compacted duff.	6
Volumetric flow rate	VFx	m^3/yr	2.87E+09	Estimated for the Bahia de Jobos waterbody using a waterbody area of 1.97E+07 m^2, a tidal range of 0.197 m, and 2 tidal exchanges per day. The volumetric flow rate from the watershed area was estimated to be negligible at 2.15E+07 m^3/yr based on runoff.	calculated
Watershed area	wa	m^2	8.66E+07	Estimated from USGS topographic map of the watershed area.	calculated
Impervious watershed cover	wa	m^2	4.33E+06	Estimated using 5 percent impervious cover based on review of USGS topographic maps.	calculated

References:

1. National Oceanic and Atmospheric Administration at http://www.srh.noaa.gov/sju/pr_mean_annual_pcp.jpg (accessed October 19, 2006).
2. U.S. Geological Survey (USGS), 2005. Water Resources Data Puerto Rico and the U.S. Virgin Islands Water Year 2003. USGS Water Data Report PR-03-1.
3. U.S. Environmental Protection Agency (EPA), 1998. Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions, EPA 600/R-98/137.
4. U.S. Geological Survey (USGS), 2005. Estimated Water Use in Puerto Rico, 2000, USGS Open-File Report 2005-1201.
5. U.S. Geological Survey (USGS), 1997. Ground-Water Use from the Principal Aquifers in Puerto Rico During Calendar Year 1990, Fact Sheet FS-188-96.
6. U.S. Department of Agriculture, 1978. Predicting Rainfall Erosion Losses - A Guide to Conservation Planning, USDA Handbook 537.

Table 6-1
Exposure Assumption Parameters
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Description	Units	Resident		Farmer		Fisher	
		Adult	Child	Adult	Child	Adult	Child
Averaging time for carcinogens	yr	70	70	70	70	70	70
Averaging time for non carcinogens	yr	30	6	40	6	30	6
Consumption rate of BEEF	kg/kg-day FW	0	0	0.00122	0.00075	0	0
Body weight	kg	70	15	70	15	70	15
Consumption rate of POULTRY	kg/kg-day FW	0	0	0.00066	0.00045	0	0
Consumption rate of ABOVEGROUND PRODUCE	kg/kg-day DW	0.00032	0.00077	0.00047	0.00113	0.00032	0.00077
Consumption rate of BELOWGROUND PRODUCE	kg/kg-day DW	0.00014	0.00023	0.00017	0.00028	0.00014	0.00023
Consumption rate of PROTECTED ABOVEGROUND	kg/kg-day DW	0.00061	0.0015	0.00064	0.00157	0.00061	0.0015
Consumption rate of SOIL	kg/d	0.0001	0.0002	0.0001	0.0002	0.0001	0.0002
Exposure duration	yr	30	6	40	6	30	6
Exposure frequency	day/yr	350	350	350	350	350	350
Consumption rate of EGGS	kg/kg-day FW	0	0	0.00075	0.00054	0	0
Fraction of contaminated ABOVEGROUND PRODUCE	--	1	1	1	1	1	1
Fraction contaminated SOIL	--	1	1	1	1	1	1
Consumption rate of FISH	kg/kg-day FW	0	0	0	0	0.00125	0.00088
Fraction of contaminated FISH	--	1	1	1	1	1	1
Inhalation exposure duration	yr	30	6	40	6	30	6
Inhalation exposure frequency	day/yr	350	350	350	350	350	350
Inhalation exposure time	hr/day	24	24	24	24	24	24
Fraction of contaminated BEEF	--	1	1	1	1	1	1
Fraction of contaminated POULTRY	--	1	1	1	1	1	1
Fraction of contaminated EGGS	--	1	1	1	1	1	1
Fraction of contaminated MILK	--	1	1	1	1	1	1
Fraction of contaminated PORK	--	1	1	1	1	1	1
Inhalation rate	m^3/hr	0.83	0.3	0.83	0.3	0.83	0.3
Consumption rate of MILK	kg/kg-day FW	0	0	0.01367	0.02268	0	0
Consumption rate of PORK	kg/kg-day FW	0	0	0.00055	0.00042	0	0
Time period at the beginning of combustion	yr	0	0	0	0	0	0
Length of exposure duration	yr	30	6	40	6	30	6

Table 7-1
Dose Response Values
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

COPC	RfDo mg/kg-day	RfC mg/m^3	CSFo (1/(mg/kg/day)	URFi ug/m^3	AIEC mg/m^3
Acetaldehyde	0.04	0.009	--	2.2E-06	81.05
Acetone	0.9	0.35	--	--	475
Aroclor 1016	7.0E-05	2.5E-04	0.07	--	0.6
Aroclor 1254	2.0E-05	7.0E-05	2	--	1.5
Chloroform (Trichloromethane)	0.01	3.0E-04	--	2.3E-05	0.15
Chromium, hexavalent	0.003	8.0E-06	--	0.012	--
Coplanar PCBs	--	--	150000	--	--
Fluoranthene	0.04	0.14	--	--	0.015
Formaldehyde	0.2	9.8E-03	1.3E-05	1.3E-05	0.094
Methanol	0.5	4	--	--	28
Methyl mercury	1.0E-04	3.5E-04	--	--	0.03
Methylene chloride	0.06	3	7.5E-03	4.7E-07	14
Propionaldehyde	0.008	0.18	--	--	--
Pyrene	0.03	0.11	--	--	15
Toluene	0.2	0.4	--	--	37
Xylene, m-	0.2	0.1	--	--	22
Antimony	4.0E-04	1.4E-03	--	--	1.5
Arsenic	3.0E-04	3.0E-05	1.5	4.3E-03	0.00019
Barium	0.07	5.0E-04	--	--	1.5
Beryllium	0.002	2.0E-05	--	2.4E-03	0.005
Cadmium	4.0E-04	2.0E-04	0.38	1.8E-03	0.03
Chromium	1.5	5.3	--	--	1.5
Lead	4.3E-04	1.5E-03	8.5E-03	1.2E-05	0.15
Mercuric chloride	3.0E-04	1.1E-03	--	--	0.12
Mercury	8.6E-05	3.0E-04	--	--	0.0018
Nickel	0.02	2.0E-04	--	2.4E-04	0.006
Selenium	0.005	0.02	--	--	1.47
Silver	0.005	0.018	--	--	0.3
Thallium	--	--	--	--	0.3
Zinc	0.3	5.3	--	--	30
TetraCDD, 2,3,7,8-	1.0E-09	--	150000	--	0.0015
HexaCDD, 1,2,3,4,7,8-	--	--	--	--	0.0012
HexaCDD, 1,2,3,6,7,8-	--	--	0.0062	1.3	0.015
HexaCDD, 1,2,3,7,8,9-	--	--	0.0062	1.3	0.015
PentaCDD, 1,2,3,7,8-	--	--	--	--	0.0025
HeptaCDD, 1,2,3,4,6,7,8-	--	--	--	--	0.6
OctaCDD, 1,2,3,4,6,7,8,9-	--	--	--	--	0.075
TetraCDF, 2,3,7,8-	--	--	--	--	0.002
PentaCDF, 1,2,3,7,8-	--	--	--	--	0.0075
PentaCDF, 2,3,4,7,8-	--	--	--	--	0.000075
HexaCDF, 1,2,3,4,7,8-	--	--	--	--	0.0075
HexaCDF, 1,2,3,6,7,8-	--	--	--	--	0.0025
HexaCDF, 1,2,3,7,8,9-	--	--	--	--	0.12
HexaCDF, 2,3,4,6,7,8-	--	--	--	--	0.0015
HeptaCDF, 1,2,3,4,6,7,8-	--	--	--	--	0.15
HeptaCDF, 1,2,3,4,7,8,9-	--	--	--	--	0.25
OctaCDF, 1,2,3,4,6,7,8,9-	--	--	--	--	0.0075

Table 8-1
Total Cancer Risk and Noncancer Hazard Summary
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Exposure Scenario	Exposure Location	Source	Cancer Risk		Hazard Index	
			Adult	Child	Adult	Child
Resident	RI_1	Area 1	7.1E-08	1.4E-08	1.7E-02	1.7E-02
		Area 2	2.7E-08	5.4E-09	7.2E-03	7.2E-03
		Area 3	2.9E-10	5.9E-11	9.5E-07	9.7E-07
		Area 4	3.6E-11	7.3E-12	1.2E-07	1.2E-07
		Scrubber	3.7E-07	7.5E-08	6.8E-02	6.8E-02
		Stack	9.1E-08	5.1E-08	1.5E-02	4.0E-02
		Total	**5.6E-07**	**1.5E-07**	**1.1E-01**	**1.3E-01**
Fisher	RI_1	Area 1	7.1E-08	1.4E-08	1.7E-02	1.7E-02
		Area 2	2.7E-08	5.4E-09	7.2E-03	7.2E-03
		Area 3	2.9E-10	5.9E-11	9.6E-07	9.7E-07
		Area 4	3.6E-11	7.3E-12	1.2E-07	1.2E-07
		Scrubber	3.7E-07	7.5E-08	6.8E-02	6.8E-02
		Stack	1.2E-06	2.0E-07	1.5E-01	1.3E-01
		Total	**1.6E-06**	**3.0E-07**	**2.4E-01**	**2.3E-01**
Farmer	RI_2	Area 1	7.9E-11	1.2E-11	1.5E-05	1.5E-05
		Area 2	6.2E-11	9.4E-12	1.2E-05	1.2E-05
		Area 3	4.1E-13	6.2E-14	1.0E-09	1.0E-09
		Area 4	9.2E-14	1.4E-14	2.3E-10	2.3E-10
		Scrubber	1.5E-09	2.3E-10	2.1E-04	2.1E-04
		Stack	1.1E-08	2.3E-09	9.6E-04	1.5E-03
		Total	**1.3E-08**	**2.6E-09**	**1.2E-03**	**1.7E-03**
Jobos Child	RI_3	Area 1	--	2.9E-10	--	3.5E-04
		Area 2	--	2.3E-10	--	3.0E-04
		Area 3	--	1.6E-12	--	2.6E-08
		Area 4	--	2.8E-13	--	4.7E-09
		Scrubber	--	3.9E-09	--	3.5E-03
		Stack	--	7.6E-09	--	6.4E-03
		Total	--	**1.2E-08**	--	**1.1E-02**

Note: Reference Figure 4-4 for an illustration of exposure locations.

Table 8-2
Cancer Risk by Exposure Pathway, All Exposure Scenarios
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Cancer Risk by Exposure Pathway							
	Resident		Fisher		Farmer		Jobos
	Adult	Child	Adult	Child	Adult	Child	Child
Inhalation	4.8E-07	9.7E-08	4.8E-07	9.7E-08	1.9E-09	2.9E-10	5.2E-09
Soil Ingestion	8.9E-09	1.7E-08	8.9E-09	1.7E-08	1.1E-10	1.3E-10	2.5E-09
Produce	6.8E-08	3.1E-08	6.8E-08	3.1E-08	8.7E-10	2.8E-10	4.3E-09
Beef	--	--	--	--	2.6E-09	2.2E-10	--
Chicken	--	--	--	--	2.7E-11	2.5E-12	--
Eggs	--	--	--	--	1.7E-11	1.7E-12	--
Milk	--	--	--	--	6.8E-09	1.6E-09	--
Pork	--	--	--	--	6.6E-10	6.8E-11	--
Fish	--	--	1.1E-06	1.5E-07	--	--	--
Total	**5.6E-07**	**1.5E-07**	**5.6E-07**	**1.5E-07**	**1.3E-08**	**2.6E-09**	**1.2E-08**

-- Pathway not included in exposure scenario

Table 8-3
Noncancer Hazard by Exposure Pathway, All Exposure Scenarios
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Noncancer Hazard by Exposure Pathway							
	Resident		Fisher		Farmer		Jobos
	Adult	Child	Adult	Child	Adult	Child	Child
Inhalation	9.5E-02	9.5E-02	9.5E-02	9.5E-02	2.7E-04	2.7E-04	4.7E-03
Soil Ingestion	1.1E-03	9.8E-03	1.1E-03	9.8E-03	8.5E-06	8.0E-05	1.5E-03
Produce	1.2E-02	2.8E-02	1.2E-02	2.8E-02	1.1E-04	2.7E-04	4.3E-03
Beef	--	--	--	--	1.8E-04	1.1E-04	--
Chicken	--	--	--	--	2.5E-06	1.7E-06	--
Eggs	--	--	--	--	1.8E-06	1.3E-06	--
Milk	--	--	--	--	5.7E-04	9.4E-04	--
Pork	--	--	--	--	5.7E-05	4.4E-05	--
Fish	--	--	1.3E-01	9.3E-02	--	--	--
Total	**1.1E-01**	**1.3E-01**	**1.1E-01**	**1.3E-01**	**1.2E-03**	**1.7E-03**	**1.1E-02**

-- Pathway not included in exposure scenario

Table 8-4
Cancer Risk by COPC, Resident Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Resident Adult, Cancer Risk, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	1.65E-10	5.09E-08	2.10E-08	0.00E+00	0.00E+00	2.00E-07	2.72E-07
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	5.06E-11	2.02E-08	5.96E-09	2.94E-10	3.61E-11	1.72E-07	1.98E-07
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	1.07E-10	--	--	--	--	--	1.07E-10
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	9.40E-09	--	--	--	--	--	9.40E-09
Aroclor 1254	2.80E-08	--	--	--	--	--	2.80E-08
Arsenic	1.44E-08	--	--	--	--	--	1.44E-08
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	1.94E-09	--	--	--	--	--	1.94E-09
Cadmium	2.57E-09	--	--	--	--	--	2.57E-09
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	2.44E-08	--	--	--	--	--	2.44E-08
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	1.56E-09	--	--	--	--	--	1.56E-09
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	1.41E-11	--	--	--	--	--	1.41E-11
HexaCDD, 1,2,3,7,8,9-	7.21E-12	--	--	--	--	--	7.21E-12
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.48E-10	--	--	--	--	--	2.48E-10
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	4.84E-09	--	--	--	--	--	4.84E-09
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	3.71E-09	--	--	--	--	--	3.71E-09
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**9.1E-08**	**7.1E-08**	**2.7E-08**	**2.9E-10**	**3.6E-11**	**3.7E-07**	**5.6E-07**

-- Not a constituent of concern

Table 8-5
Cancer Risk by COPC, Resident Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Resident Child, Cancer Risk, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	3.29E-11	1.02E-08	4.21E-09	0.00E+00	0.00E+00	4.00E-08	5.44E-08
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	1.03E-11	4.06E-09	1.20E-09	5.92E-11	7.27E-12	3.47E-08	4.00E-08
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	2.15E-11	--	--	--	--	--	2.15E-11
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	5.30E-09	--	--	--	--	--	5.30E-09
Aroclor 1254	1.88E-08	--	--	--	--	--	1.88E-08
Arsenic	5.15E-09	--	--	--	--	--	5.15E-09
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	3.87E-10	--	--	--	--	--	3.87E-10
Cadmium	8.28E-10	--	--	--	--	--	8.28E-10
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	1.64E-08	--	--	--	--	--	1.64E-08
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	3.12E-10	--	--	--	--	--	3.12E-10
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	2.83E-12	--	--	--	--	--	2.83E-12
HexaCDD, 1,2,3,7,8,9-	1.44E-12	--	--	--	--	--	1.44E-12
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.00E-10	--	--	--	--	--	1.00E-10
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	9.68E-10	--	--	--	--	--	9.68E-10
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	2.36E-09	--	--	--	--	--	2.36E-09
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**5.1E-08**	**1.4E-08**	**5.4E-09**	**5.9E-11**	**7.3E-12**	**7.5E-08**	**1.5E-07**

-- Not a constituent of concern

Table 8-6
Noncancer Hazard by COPC, Resident Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Resident Adult, Noncancer, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	6.85E-08	2.09E-05	8.65E-06	0.00E+00	0.00E+00	9.74E-05	1.27E-04
Choloroform (Trichloromethane)	5.57E-05	1.72E-02	7.11E-03	0.00E+00	0.00E+00	6.76E-02	9.20E-02
Methanol	1.44E-08	2.92E-06	1.21E-06	0.00E+00	0.00E+00	8.36E-06	1.25E-05
Methylene chloride	8.72E-08	3.41E-05	1.01E-05	4.97E-07	6.10E-08	2.91E-04	3.36E-04
Toluene	2.81E-07	6.35E-05	2.25E-05	4.58E-07	5.63E-08	3.92E-05	1.26E-04
Xylene, m-	1.67E-07	5.17E-05	2.14E-05	0.00E+00	0.00E+00	9.77E-06	8.30E-05
Acetaldehyde	1.27E-05	--	--	--	--	--	1.27E-05
Antimony	5.51E-04	--	--	--	--	--	5.51E-04
Aroclor 1016	8.06E-03	--	--	--	--	--	8.06E-03
Aroclor 1254	3.16E-03	--	--	--	--	--	3.16E-03
Arsenic	1.57E-04	--	--	--	--	--	1.57E-04
Barium	3.56E-05	--	--	--	--	--	3.56E-05
Beryllium	9.76E-05	--	--	--	--	--	9.76E-05
Cadmium	2.66E-05	--	--	--	--	--	2.66E-05
Chromium	2.00E-07	--	--	--	--	--	2.00E-07
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	2.15E-07	--	--	--	--	--	2.15E-07
Formaldehyde	3.11E-05	--	--	--	--	--	3.11E-05
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.24E-04	--	--	--	--	--	1.24E-04
Mercuric chloride	1.67E-03	--	--	--	--	--	1.67E-03
Mercury	2.14E-07	--	--	--	--	--	2.14E-07
Methyl mercury	2.56E-04	--	--	--	--	--	2.56E-04
Nickel	2.44E-04	--	--	--	--	--	2.44E-04
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.16E-06	--	--	--	--	--	1.16E-06
Pyrene	1.52E-06	--	--	--	--	--	1.52E-06
Selenium	1.17E-04	--	--	--	--	--	1.17E-04
Silver	5.15E-04	--	--	--	--	--	5.15E-04
TetraCDD, 2,3,7,8-	8.28E-05	--	--	--	--	--	8.28E-05
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	1.11E-07	--	--	--	--	--	1.11E-07
Total	**1.5E-02**	**1.7E-02**	**7.2E-03**	**9.5E-07**	**1.2E-07**	**6.8E-02**	**1.1E-01**

-- Not a constituent of concern

Table 8-7
Noncancer Hazard by COPC, Resident Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Resident Child, Noncancer Hazard, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	7.01E-08	2.12E-05	8.76E-06	0.00E+00	0.00E+00	9.88E-05	1.29E-04
Choloroform (Trichloromethane)	5.57E-05	1.72E-02	7.11E-03	0.00E+00	0.00E+00	6.76E-02	9.20E-02
Methanol	2.11E-08	3.99E-06	1.66E-06	0.00E+00	0.00E+00	1.15E-05	1.72E-05
Methylene chloride	9.10E-08	3.48E-05	1.03E-05	5.08E-07	6.24E-08	2.98E-04	3.44E-04
Toluene	2.82E-07	6.36E-05	2.26E-05	4.58E-07	5.63E-08	3.92E-05	1.26E-04
Xylene, m-	1.68E-07	5.18E-05	2.14E-05	0.00E+00	0.00E+00	9.78E-06	8.31E-05
Acetaldehyde	1.28E-05	--	--	--	--	--	1.28E-05
Antimony	5.52E-04	--	--	--	--	--	5.52E-04
Aroclor 1016	2.18E-02	--	--	--	--	--	2.18E-02
Aroclor 1254	9.77E-03	--	--	--	--	--	9.77E-03
Arsenic	2.15E-04	--	--	--	--	--	2.15E-04
Barium	4.25E-05	--	--	--	--	--	4.25E-05
Beryllium	1.02E-04	--	--	--	--	--	1.02E-04
Cadmium	5.07E-05	--	--	--	--	--	5.07E-05
Chromium	5.41E-07	--	--	--	--	--	5.41E-07
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	4.90E-07	--	--	--	--	--	4.90E-07
Formaldehyde	3.31E-05	--	--	--	--	--	3.31E-05
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.85E-04	--	--	--	--	--	2.85E-04
Mercuric chloride	4.51E-03	--	--	--	--	--	4.51E-03
Mercury	2.14E-07	--	--	--	--	--	2.14E-07
Methyl mercury	6.16E-04	--	--	--	--	--	6.16E-04
Nickel	2.56E-04	--	--	--	--	--	2.56E-04
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.41E-06	--	--	--	--	--	1.41E-06
Pyrene	3.84E-06	--	--	--	--	--	3.84E-06
Selenium	2.71E-04	--	--	--	--	--	2.71E-04
Silver	1.24E-03	--	--	--	--	--	1.24E-03
TetraCDD, 2,3,7,8-	2.75E-04	--	--	--	--	--	2.75E-04
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	2.64E-07	--	--	--	--	--	2.64E-07
Total	**4.0E-02**	**1.7E-02**	**7.2E-03**	**9.7E-07**	**1.2E-07**	**6.8E-02**	**1.3E-01**

-- Not a constituent of concern

Table 8-8
Cancer Risk by COPC, Fisher Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Fisher Adult, Cancer Risk, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	1.65E-10	5.09E-08	2.10E-08	0.00E+00	0.00E+00	2.00E-07	2.72E-07
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	5.07E-11	2.02E-08	5.96E-09	2.94E-10	3.61E-11	1.72E-07	1.98E-07
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	1.07E-10	--	--	--	--	--	1.07E-10
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	3.00E-08	--	--	--	--	--	3.00E-08
Aroclor 1254	5.93E-07	--	--	--	--	--	5.93E-07
Arsenic	1.45E-08	--	--	--	--	--	1.45E-08
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	1.94E-09	--	--	--	--	--	1.94E-09
Cadmium	2.72E-09	--	--	--	--	--	2.72E-09
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	5.16E-07	--	--	--	--	--	5.16E-07
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	1.56E-09	--	--	--	--	--	1.56E-09
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	1.41E-11	--	--	--	--	--	1.41E-11
HexaCDD, 1,2,3,7,8,9-	7.21E-12	--	--	--	--	--	7.21E-12
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.48E-10	--	--	--	--	--	2.48E-10
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	4.84E-09	--	--	--	--	--	4.84E-09
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	6.23E-09	--	--	--	--	--	6.23E-09
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**1.2E-06**	**7.1E-08**	**2.7E-08**	**2.9E-10**	**3.6E-11**	**3.7E-07**	**1.6E-06**

-- Not a constituent of concern

Table 8-9
Cancer Risk by COPC, Fisher Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Fisher Child, Cancer Risk, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	3.29E-11	1.02E-08	4.21E-09	0.00E+00	0.00E+00	4.00E-08	5.44E-08
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	1.03E-11	4.06E-09	1.20E-09	5.92E-11	7.28E-12	3.47E-08	4.00E-08
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	2.15E-11	--	--	--	--	--	2.15E-11
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	8.19E-09	--	--	--	--	--	8.19E-09
Aroclor 1254	9.84E-08	--	--	--	--	--	9.84E-08
Arsenic	5.17E-09	--	--	--	--	--	5.17E-09
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	3.87E-10	--	--	--	--	--	3.87E-10
Cadmium	8.49E-10	--	--	--	--	--	8.49E-10
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	8.56E-08	--	--	--	--	--	8.56E-08
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	3.12E-10	--	--	--	--	--	3.12E-10
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	2.83E-12	--	--	--	--	--	2.83E-12
HexaCDD, 1,2,3,7,8,9-	1.44E-12	--	--	--	--	--	1.44E-12
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.00E-10	--	--	--	--	--	1.00E-10
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	9.68E-10	--	--	--	--	--	9.68E-10
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	2.71E-09	--	--	--	--	--	2.71E-09
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**2.0E-07**	**1.4E-08**	**5.4E-09**	**5.9E-11**	**7.3E-12**	**7.5E-08**	**3.0E-07**

-- Not a constituent of concern

Table 8-10
Noncancer Hazard by COPC, Fisher Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Fisher Adult, Noncancer, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	6.85E-08	2.09E-05	8.65E-06	0.00E+00	0.00E+00	9.74E-05	1.27E-04
Choloroform (Trichloromethane)	5.57E-05	1.72E-02	7.11E-03	0.00E+00	0.00E+00	6.76E-02	9.20E-02
Methanol	1.44E-08	2.92E-06	1.21E-06	0.00E+00	0.00E+00	8.37E-06	1.25E-05
Methylene chloride	8.78E-08	3.41E-05	1.01E-05	4.97E-07	6.11E-08	2.92E-04	3.36E-04
Toluene	2.82E-07	6.35E-05	2.25E-05	4.58E-07	5.63E-08	3.92E-05	1.26E-04
Xylene, m-	1.68E-07	5.17E-05	2.14E-05	0.00E+00	0.00E+00	9.77E-06	8.30E-05
Acetaldehyde	1.27E-05	--	--	--	--	--	1.27E-05
Antimony	5.57E-04	--	--	--	--	--	5.57E-04
Aroclor 1016	1.86E-02	--	--	--	--	--	1.86E-02
Aroclor 1254	3.80E-02	--	--	--	--	--	3.80E-02
Arsenic	1.57E-04	--	--	--	--	--	1.57E-04
Barium	3.58E-05	--	--	--	--	--	3.58E-05
Beryllium	9.76E-05	--	--	--	--	--	9.76E-05
Cadmium	2.88E-05	--	--	--	--	--	2.88E-05
Chromium	2.01E-07	--	--	--	--	--	2.01E-07
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	3.44E-07	--	--	--	--	--	3.44E-07
Formaldehyde	3.11E-05	--	--	--	--	--	3.11E-05
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.24E-04	--	--	--	--	--	1.24E-04
Mercuric chloride	1.67E-03	--	--	--	--	--	1.67E-03
Mercury	2.14E-07	--	--	--	--	--	2.14E-07
Methyl mercury	8.68E-02	--	--	--	--	--	8.68E-02
Nickel	2.44E-04	--	--	--	--	--	2.44E-04
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.16E-06	--	--	--	--	--	1.16E-06
Pyrene	1.71E-06	--	--	--	--	--	1.71E-06
Selenium	1.19E-04	--	--	--	--	--	1.19E-04
Silver	5.19E-04	--	--	--	--	--	5.19E-04
TetraCDD, 2,3,7,8-	1.24E-04	--	--	--	--	--	1.24E-04
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	1.44E-07	--	--	--	--	--	1.44E-07
Total	**1.5E-01**	**1.7E-02**	**7.2E-03**	**9.6E-07**	**1.2E-07**	**6.8E-02**	**2.4E-01**

-- Not a constituent of concern

Table 8-11
Noncancer Hazard by COPC, Fisher Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Fisher Child, Noncancer, Receptor Location RI_1							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	7.01E-08	2.12E-05	8.76E-06	0.00E+00	0.00E+00	9.88E-05	1.29E-04
Choloroform (Trichloromethane)	5.57E-05	1.72E-02	7.11E-03	0.00E+00	0.00E+00	6.76E-02	9.20E-02
Methanol	2.11E-08	3.99E-06	1.66E-06	0.00E+00	0.00E+00	1.16E-05	1.72E-05
Methylene chloride	9.13E-08	3.49E-05	1.03E-05	5.08E-07	6.25E-08	2.99E-04	3.45E-04
Toluene	2.82E-07	6.36E-05	2.26E-05	4.59E-07	5.64E-08	3.92E-05	1.26E-04
Xylene, m-	1.68E-07	5.18E-05	2.14E-05	0.00E+00	0.00E+00	9.78E-06	8.31E-05
Acetaldehyde	1.28E-05	--	--	--	--	--	1.28E-05
Antimony	5.56E-04	--	--	--	--	--	5.56E-04
Aroclor 1016	2.93E-02	--	--	--	--	--	2.93E-02
Aroclor 1254	3.43E-02	--	--	--	--	--	3.43E-02
Arsenic	2.16E-04	--	--	--	--	--	2.16E-04
Barium	4.26E-05	--	--	--	--	--	4.26E-05
Beryllium	1.02E-04	--	--	--	--	--	1.02E-04
Cadmium	5.23E-05	--	--	--	--	--	5.23E-05
Chromium	5.42E-07	--	--	--	--	--	5.42E-07
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	5.80E-07	--	--	--	--	--	5.80E-07
Formaldehyde	3.31E-05	--	--	--	--	--	3.31E-05
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.85E-04	--	--	--	--	--	2.85E-04
Mercuric chloride	4.51E-03	--	--	--	--	--	4.51E-03
Mercury	2.14E-07	--	--	--	--	--	2.14E-07
Methyl mercury	6.16E-02	--	--	--	--	--	6.16E-02
Nickel	2.56E-04	--	--	--	--	--	2.56E-04
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.41E-06	--	--	--	--	--	1.41E-06
Pyrene	3.97E-06	--	--	--	--	--	3.97E-06
Selenium	2.72E-04	--	--	--	--	--	2.72E-04
Silver	1.24E-03	--	--	--	--	--	1.24E-03
TetraCDD, 2,3,7,8-	3.04E-04	--	--	--	--	--	3.04E-04
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	2.87E-07	--	--	--	--	--	2.87E-07
Total	**1.3E-01**	**1.7E-02**	**7.2E-03**	**9.7E-07**	**1.2E-07**	**6.8E-02**	**2.3E-01**

-- Not a constituent of concern

Table 8-12
Cancer Risk by COPC, Farmer Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Farmer Adult, Cancer Risk, Receptor Location RI_2							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	3.27E-12	5.67E-11	4.86E-11	0.00E+00	0.00E+00	8.30E-10	9.38E-10
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	9.97E-13	2.24E-11	1.37E-11	4.06E-13	9.19E-14	7.13E-10	7.50E-10
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	2.14E-12	--	--	--	--	--	2.14E-12
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	9.26E-10	--	--	--	--	--	9.26E-10
Aroclor 1254	4.69E-09	--	--	--	--	--	4.69E-09
Arsenic	2.08E-10	--	--	--	--	--	2.08E-10
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	2.98E-11	--	--	--	--	--	2.98E-11
Cadmium	3.12E-11	--	--	--	--	--	3.12E-11
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	4.08E-09	--	--	--	--	--	4.08E-09
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	3.09E-11	--	--	--	--	--	3.09E-11
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	2.31E-13	--	--	--	--	--	2.31E-13
HexaCDD, 1,2,3,7,8,9-	1.18E-13	--	--	--	--	--	1.18E-13
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	4.07E-12	--	--	--	--	--	4.07E-12
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	7.44E-11	--	--	--	--	--	7.44E-11
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	1.24E-09	--	--	--	--	--	1.24E-09
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**1.1E-08**	**7.9E-11**	**6.2E-11**	**4.1E-13**	**9.2E-14**	**1.5E-09**	**1.3E-08**

-- Not a constituent of concern

Table 8-13
Cancer Risk by COPC, Farmer Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Farmer Child, Cancer Risk, Receptor Location RI_2							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	4.91E-13	8.50E-12	7.28E-12	0.00E+00	0.00E+00	1.24E-10	1.41E-10
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	1.51E-13	3.40E-12	2.09E-12	6.17E-14	1.40E-14	1.08E-10	1.14E-10
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	3.20E-13	--	--	--	--	--	3.20E-13
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	1.93E-10	--	--	--	--	--	1.93E-10
Aroclor 1254	9.63E-10	--	--	--	--	--	9.63E-10
Arsenic	4.36E-11	--	--	--	--	--	4.36E-11
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	4.46E-12	--	--	--	--	--	4.46E-12
Cadmium	6.44E-12	--	--	--	--	--	6.44E-12
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	8.38E-10	--	--	--	--	--	8.38E-10
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	4.64E-12	--	--	--	--	--	4.64E-12
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	3.47E-14	--	--	--	--	--	3.47E-14
HexaCDD, 1,2,3,7,8,9-	1.77E-14	--	--	--	--	--	1.77E-14
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.04E-12	--	--	--	--	--	1.04E-12
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	1.12E-11	--	--	--	--	--	1.12E-11
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	2.66E-10	--	--	--	--	--	2.66E-10
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**2.3E-09**	**1.2E-11**	**9.4E-12**	**6.2E-14**	**1.4E-14**	**2.3E-10**	**2.6E-09**

-- Not a constituent of concern

Table 8-14
Noncancer Hazard by COPC, Farmer Adult
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Farmer Adult, Noncancer Hazard, Receptor Location RI_2							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	1.01E-09	1.75E-08	1.50E-08	0.00E+00	0.00E+00	3.04E-07	3.37E-07
Choloroform (Trichloromethane)	8.30E-07	1.44E-05	1.23E-05	0.00E+00	0.00E+00	2.10E-04	2.38E-04
Methanol	1.67E-10	2.78E-09	2.38E-09	0.00E+00	0.00E+00	2.89E-08	3.43E-08
Methylene chloride	1.28E-09	2.86E-08	1.76E-08	5.20E-10	1.18E-10	9.12E-07	9.61E-07
Toluene	4.19E-09	5.30E-08	3.90E-08	4.76E-10	1.08E-10	1.22E-07	2.19E-07
Xylene, m-	2.49E-09	4.32E-08	3.70E-08	0.00E+00	0.00E+00	3.04E-08	1.13E-07
Acetaldehyde	1.89E-07	--	--	--	--	--	1.89E-07
Antimony	8.22E-06	--	--	--	--	--	8.22E-06
Aroclor 1016	5.06E-04	--	--	--	--	--	5.06E-04
Aroclor 1254	2.87E-04	--	--	--	--	--	2.87E-04
Arsenic	1.75E-06	--	--	--	--	--	1.75E-06
Barium	3.97E-07	--	--	--	--	--	3.97E-07
Beryllium	1.11E-06	--	--	--	--	--	1.11E-06
Cadmium	2.11E-07	--	--	--	--	--	2.11E-07
Chromium	8.18E-09	--	--	--	--	--	8.18E-09
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	1.46E-08	--	--	--	--	--	1.46E-08
Formaldehyde	4.51E-07	--	--	--	--	--	4.51E-07
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.55E-06	--	--	--	--	--	1.55E-06
Mercuric chloride	2.89E-05	--	--	--	--	--	2.89E-05
Mercury	2.36E-09	--	--	--	--	--	2.36E-09
Methyl mercury	2.87E-06	--	--	--	--	--	2.87E-06
Nickel	3.06E-06	--	--	--	--	--	3.06E-06
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.63E-08	--	--	--	--	--	1.63E-08
Pyrene	7.80E-08	--	--	--	--	--	7.80E-08
Selenium	1.86E-05	--	--	--	--	--	1.86E-05
Silver	8.41E-05	--	--	--	--	--	8.41E-05
TetraCDD, 2,3,7,8-	1.55E-05	--	--	--	--	--	1.55E-05
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	7.38E-10	--	--	--	--	--	7.38E-10
Total	**9.6E-04**	**1.5E-05**	**1.2E-05**	**1.0E-09**	**2.3E-10**	**2.1E-04**	**1.2E-03**

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Table 8-15
Noncancer Hazard by COPC, Farmer Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Farmer Child, Noncancer Hazard, Receptor Location RI_2							
Chemical / Source	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	1.03E-09	1.78E-08	1.52E-08	0.00E+00	0.00E+00	3.09E-07	3.43E-07
Choloroform (Trichloromethane)	8.30E-07	1.44E-05	1.23E-05	0.00E+00	0.00E+00	2.10E-04	2.38E-04
Methanol	2.36E-10	3.90E-09	3.34E-09	0.00E+00	0.00E+00	4.08E-08	4.83E-08
Methylene chloride	1.32E-09	2.95E-08	1.81E-08	5.34E-10	1.21E-10	9.39E-07	9.89E-07
Toluene	4.19E-09	5.31E-08	3.91E-08	4.76E-10	1.08E-10	1.22E-07	2.19E-07
Xylene, m-	2.50E-09	4.32E-08	3.70E-08	0.00E+00	0.00E+00	3.04E-08	1.13E-07
Acetaldehyde	1.90E-07	--	--	--	--	--	1.90E-07
Antimony	8.22E-06	--	--	--	--	--	8.22E-06
Aroclor 1016	7.70E-04	--	--	--	--	--	7.70E-04
Aroclor 1254	4.23E-04	--	--	--	--	--	4.23E-04
Arsenic	2.07E-06	--	--	--	--	--	2.07E-06
Barium	4.39E-07	--	--	--	--	--	4.39E-07
Beryllium	1.13E-06	--	--	--	--	--	1.13E-06
Cadmium	3.46E-07	--	--	--	--	--	3.46E-07
Chromium	1.32E-08	--	--	--	--	--	1.32E-08
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	2.19E-08	--	--	--	--	--	2.19E-08
Formaldehyde	4.71E-07	--	--	--	--	--	4.71E-07
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.92E-06	--	--	--	--	--	2.92E-06
Mercuric chloride	5.90E-05	--	--	--	--	--	5.90E-05
Mercury	2.36E-09	--	--	--	--	--	2.36E-09
Methyl mercury	6.30E-06	--	--	--	--	--	6.30E-06
Nickel	3.25E-06	--	--	--	--	--	3.25E-06
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	1.88E-08	--	--	--	--	--	1.88E-08
Pyrene	1.23E-07	--	--	--	--	--	1.23E-07
Selenium	3.02E-05	--	--	--	--	--	3.02E-05
Silver	1.41E-04	--	--	--	--	--	1.41E-04
TetraCDD, 2,3,7,8-	2.26E-05	--	--	--	--	--	2.26E-05
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	1.65E-09	--	--	--	--	--	1.65E-09
Total	**1.5E-03**	**1.5E-05**	**1.2E-05**	**1.0E-09**	**2.3E-10**	**2.1E-04**	**1.7E-03**

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Table 8-16
Cancer Risk by COPC, Jobos School Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Jobos School Child, Cancer Risk, Receptor Location RI_3							
Chemical	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Choloroform (Trichloromethane)	9.17E-12	2.04E-10	1.78E-10	0.00E+00	0.00E+00	2.07E-09	2.46E-09
Methanol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene chloride	2.82E-12	8.13E-11	5.08E-11	1.60E-12	2.85E-13	1.79E-09	1.93E-09
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xylene, m-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetaldehyde	5.98E-12	--	--	--	--	--	5.98E-12
Antimony	0.00E+00	--	--	--	--	--	0.00E+00
Aroclor 1016	8.42E-10	--	--	--	--	--	8.42E-10
Aroclor 1254	2.85E-09	--	--	--	--	--	2.85E-09
Arsenic	6.61E-10	--	--	--	--	--	6.61E-10
Barium	0.00E+00	--	--	--	--	--	0.00E+00
Beryllium	1.05E-10	--	--	--	--	--	1.05E-10
Cadmium	1.23E-10	--	--	--	--	--	1.23E-10
Chromium	0.00E+00	--	--	--	--	--	0.00E+00
Coplanar PCBs	2.48E-09	--	--	--	--	--	2.48E-09
Fluoranthene	0.00E+00	--	--	--	--	--	0.00E+00
Formaldehyde	8.66E-11	--	--	--	--	--	8.66E-11
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	7.64E-13	--	--	--	--	--	7.64E-13
HexaCDD, 1,2,3,7,8,9-	3.90E-13	--	--	--	--	--	3.90E-13
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	1.08E-11	--	--	--	--	--	1.08E-11
Mercuric chloride	0.00E+00	--	--	--	--	--	0.00E+00
Mercury	0.00E+00	--	--	--	--	--	0.00E+00
Methyl mercury	0.00E+00	--	--	--	--	--	0.00E+00
Nickel	2.63E-10	--	--	--	--	--	2.63E-10
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	0.00E+00	--	--	--	--	--	0.00E+00
Pyrene	0.00E+00	--	--	--	--	--	0.00E+00
Selenium	0.00E+00	--	--	--	--	--	0.00E+00
Silver	0.00E+00	--	--	--	--	--	0.00E+00
TetraCDD, 2,3,7,8-	2.09E-10	--	--	--	--	--	2.09E-10
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	0.00E+00	--	--	--	--	--	0.00E+00
Total	**7.6E-09**	**2.9E-10**	**2.3E-10**	**1.6E-12**	**2.8E-13**	**3.9E-09**	**1.2E-08**

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Table 8-17
Noncancer Hazard by COPC, Jobos School Child
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Jobos School Child, Non-Cancer, Receptor Location RI_3							
Chemical	Stack 1	Area 1	Area 2	Area 3	Area 4	Scrubber	Total
Acetone	1.91E-08	4.25E-07	3.71E-07	0.00E+00	0.00E+00	5.11E-06	5.93E-06
Choloroform (Trichloromethane)	1.55E-05	3.45E-04	3.01E-04	0.00E+00	0.00E+00	3.50E-03	4.16E-03
Methanol	3.87E-09	8.32E-08	7.24E-08	0.00E+00	0.00E+00	5.92E-07	7.52E-07
Methylene chloride	2.43E-08	6.99E-07	4.37E-07	1.37E-08	2.45E-09	1.54E-05	1.66E-05
Toluene	7.82E-08	1.27E-06	9.54E-07	1.24E-08	2.20E-09	2.03E-06	4.35E-06
Xylene, m-	4.66E-08	1.04E-06	9.04E-07	0.00E+00	0.00E+00	5.06E-07	2.49E-06
Acetaldehyde	3.54E-06	--	--	--	--	--	3.54E-06
Antimony	1.53E-04	--	--	--	--	--	1.53E-04
Aroclor 1016	3.53E-03	--	--	--	--	--	3.53E-03
Aroclor 1254	1.53E-03	--	--	--	--	--	1.53E-03
Arsenic	3.93E-05	--	--	--	--	--	3.93E-05
Barium	9.36E-06	--	--	--	--	--	9.36E-06
Beryllium	2.62E-05	--	--	--	--	--	2.62E-05
Cadmium	5.92E-06	--	--	--	--	--	5.92E-06
Chromium	4.50E-08	--	--	--	--	--	4.50E-08
Coplanar PCBs	0.00E+00	--	--	--	--	--	0.00E+00
Fluoranthene	7.95E-08	--	--	--	--	--	7.95E-08
Formaldehyde	8.66E-06	--	--	--	--	--	8.66E-06
HeptaCDD, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HeptaCDF, 1,2,3,4,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDD, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 1,2,3,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
HexaCDF, 2,3,4,6,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Lead	2.50E-05	--	--	--	--	--	2.50E-05
Mercuric chloride	7.34E-04	--	--	--	--	--	7.34E-04
Mercury	5.61E-08	--	--	--	--	--	5.61E-08
Methyl mercury	9.58E-05	--	--	--	--	--	9.58E-05
Nickel	6.55E-05	--	--	--	--	--	6.55E-05
OctaCDD, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
OctaCDF, 1,2,3,4,6,7,8,9-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDD, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 1,2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
PentaCDF, 2,3,4,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Propionaldehyde	3.38E-07	--	--	--	--	--	3.38E-07
Pyrene	6.03E-07	--	--	--	--	--	6.03E-07
Selenium	2.35E-05	--	--	--	--	--	2.35E-05
Silver	9.68E-05	--	--	--	--	--	9.68E-05
TetraCDD, 2,3,7,8-	2.44E-05	--	--	--	--	--	2.44E-05
TetraCDF, 2,3,7,8-	0.00E+00	--	--	--	--	--	0.00E+00
Thallium	0.00E+00	--	--	--	--	--	0.00E+00
Zinc	2.19E-08	--	--	--	--	--	2.19E-08
Total	**6.4E-03**	**3.5E-04**	**3.0E-04**	**2.6E-08**	**4.7E-09**	**3.5E-03**	**1.1E-02**

-- Not a constituent of concern

Table 8-18
Noncancer Dioxin Exposure to Nursing Infants and Adults
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

	Resident	Fisher	Farmer
Nursing Infant ADD (pg/kg BW-day)	1.10E-01	3.80E-01	1.10E-02
Adult ADD (pg/kg BW-day)	3.80E-03	1.30E-02	3.80E-04

Table 8-19
Lead Concentrations in Soil
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

	Resident Adult and Child	Fisher Adult and Child	Farmer Adult and Child	Jobos Child
Lead Concentration in Soil (mg/kg)	2.0E-05	2.0E-05	8.0E-08	1.5E-06

Table 8-20
Acute Inhalation Hazard
Human Health Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

	Resident Adult and Child	Fisher Adult and Child	Farmer Adult and Child	Jobos Child
Acute Inhalation Hazard	4.9E-03	4.9E-03	1.7E-04	5.1E-04

Table 9-1
Volatile Tentatively Identified Compounds
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Run	Estiamted Concentration (ug)							
	Unknown	Octane	Nonane	Isopropyl ether	Benzaldehyde	Tridecane	Tetradecane	Isoflurane
1-1-A	0.713	0.04	0.078					
1-1-B	0.056			0.025				
1-2-A	0.405							
1-2-B	0.071							
1-3-A	0.325							
1-3-B	0.03			0.025	0.03			
1-4-A	0.028			0.34				
1-4-B	0.069							
Total - Run 1	*1.697*	*0.04*	*0.078*	*0.39*	*0.03*			
2-1-A	0.422		0.029					
2-1-B	0.037				0.027			
2-2-A	0.517							
2-2-B	0.053							
2-3-A				0.4				
2-3-B	0.071							
2-4-A	0.4							
2-4-B	0.076							
Total - Run 2	*1.576*	*0*	*0.029*	*0.4*	*0.027*			
3-1-A	0.3							
3-1-B	0.026			0.022		0.039	0.029	
3-2-A				0.3				
3-2-B	0.058							
3-3-A	0.498							
3-3-B	0.047							0.027
3-4-A	0.027			0.31				
3-4-B	0.059						0.035	
Total - Run 3	*1.015*	*0*	*0*	*0.632*	*0*	*0.039*	*0.064*	*0.027*
4-1-A	0.51							
4-1-B	0.118					0.056	0.041	
4-2-A	0.479							0.13
4-2-B	0.036			0.025		0.036	0.031	
4-3-A	0.59							
4-3-B	0.037					0.027		
4-4-A	0.545							
4-4-B	not analyzed							
Total - Run 4	*2.315*	*0*	*0*	*0.025*	*0*	*0.119*	*0.072*	*0.13*

Source: Comprehensive Performance Test Report, Trane Hazardous Waste Incinerators, API Industies, Inc., Guayama, Puerto Rico, Appendix E, TRC Environmental Corporation, June 2006

Table 9-2
Semi-Volatile Tentatively Identified Compounds
Human Health Risk Assessment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Compound	Estimated Concentration (ug)			
	Run 1	Run 2	Run 3	Run 4
Unknown	973	1400	1000	1859
Benzoic acid, methyl ester	10	33	8.5	34
2-propenoic acid, 3-4 methoxy	27			
3-penten-2-one, 4-methyl-		9.6		14
Benzaldehyde		8.8		
Decane		10		
Acetic acid, octadecyl ester				15
TOTAL	*1010*	*1461*	*1009*	*1922*

Source: Comprehensive Performance Test Report, Trane Hazardous Waste Incinerators, API Industies, Inc., Guayama, Puerto Rico, Appendix E, TRC Environmental Corporation, June 2006

Table 9-3
Total Organic Emission Factor Calculation
Human Health Risk Assessment
TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

Total Organic Emissions		
Parameter	Emission Rate (g/s)	Source
C1 - C7 compounds	5.29E-03	CPT Report, Table 7-2, only C1 and C5 detected
C8 - C17 compounds	4.83E-03	CPT Report, Table 7-3
Gravimetric compounds	8.20E-04	CPT Report, Table 7-3
Total	*1.09E-02*	

Identifed Organic Emissions		
Parameter	Emission Rate (g/s)	Source
VOCs	Insignificant	
SVOCs	3.51E-06	HHRA, Table 2-6, not adjusted for process upsets
Aldehydes	1.25E-04	HHRA, Table 2-6, not adjusted for process upsets
PCBs	3.34E-05	HHRA, Table 2-5, not adjusted for process upsets
Dioxin/furan	Insignificant	
Methane	1.81E-03	CPT Report, Table 7-2, C1 identified as methane
TICs	Insignificant	
Total	*1.97E-03*	

TOE Factor Calculation		
Total Organic Emissions (g/s)	1.09E-02	
Identified Organic Emissions (g/s)	1.97E-03	
TOE Factor	**5.5**	

Note: Compounds not detected during CPT stack testing are not included in emissions rates

Table 10-1
Threatened and Endangered Species
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

Common Name	Scientific Name	Biological Resource Description	Endangered (E) Threatened (T)
Guayama-Aguirre			
Latherback sea turtle	Dermochelys coriacea	Reptile	E
Hawksbill sea turtle	Eretmochelys imbricata	Reptile	E
Puerto Rican boa	Epicrates inornatus	Reptile	E
West Indian manatee	Trichechus manatus	Mammal	E
Yellow-Shoulder blackbird	Agelaius xanthomus	Bird	E
Brown Pelican	Pelecanus occidentalis	Bird	E
Puerto Rican plain pigeon	Columba inornata wetmorei	Bird	E
Piping plover	Charadrius melodus	Bird	T
Cayey			
Puerto Rican boa	Epicrates inornatus	Reptile	E
Golden caqui	Eleutherodactylus jasperi	Amphibian	E
Puerto Rican plain pigeon	Columba inornata wetmorei	Bird	E
Puerto Rican Sharp-Skinned hawks	Accipiter inornata wetmorei	Bird	E
Puerto Rican Broad-Winged hawks	Buteo platypterus brunnescens	Bird	E
	Banara vanderviltii	plant	E
	Eugenia haematocarpa	plant	E
Patillas			
Leatherback sea turtle	Dermochelys coriacea	Reptile	E
Hawksbill sea turtle	Eretmochelys imbricata	Reptile	E
Green sea turtle	Chelonia mydas	Reptile	E
Puerto Rican rock frog	Eleutherodactylus cooki	Amphibian	T
West Indian manatee	Trichechus manatus	Mammal	E

Source: U.S Fish and Wildlife Service (USFWS, 2006)

Table 10-2
Ecological Evaluation: Organics in Soil
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

	EPA Eco-SSLs[1]	EPA Region 5 SSLs[2]	EPA Region 4 ESVs[3]	Selected ESL	Media Concentration ug/kg
(Concentration units are in ug/kg)					
Acetaldehyde	--	--	--	--	1.48E-05
Acetone	--	2500	--	2500	8.96E-02
Chloroform	--	1190	--	1190	6.72E-04
Dioxins	--	--	--	--	4.74E-04
Fluoranthene	--	1.22E+05	100	100	1.39E-01
Formaldehyde	--	--	--	--	1.08E-02
Furans	--	--	6.E+05	6.E+05	3.00E-03
Methanol	--	--	--	--	7.22E-03
Methylene Chloride	--	4050	--	4050	1.25E-02
PCBs	--	0.332	20	0.332	7.21E-02
Propionaldehyde	--	--	--	--	1.54E-04
Pyrene	--	7.85E+04	100	100	8.14E-03
Toluene	--	5450	50	50	3.56E-03
Xylene	--	1.00E+04	50	50	1.45E-03

-- not available

Notes:

1. EPA ecological screening level (EPA, 2005b). No EPA Eco-SSLs currently available for organics compounds
2. EPA Region 5 ecological soil screening levels (EPA, 2003)
3. EPA Region 4 ecological screening values (EPA, 1999b)

Table 10-3
Ecological Evaluation:Metals in Soil
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

(Concentration units are in mg/kg)	Eco-SSLs[1] Plants	Eco-SSL Invertebrates	Eco-SSL Avian Wildlife	Mammalian Wildlife	EPA Region 4 ESVs[2]	EPA Region 5 SSLs[3]	Selected ESL	Media Concentration mg/kg
Antimony	N	Y	N	Y	3.5	0.142	0.27	3.80E-06
Arsenic	Y	N	Y	Y	10	5.7	18	5.26E-09
Barium	N	Y	N	Y	165	1.04	330	7.43E-03
Beryllium	N	Y	N	Y	1.1	1.06	21	4.00E-06
Cadmium	Y	Y	Y	Y	1.6	0.002	0.36	1.84E-07
Chromium (+3)	N	N	Y	Y	0.4	0.4	26	1.24E-02
Lead	Y	Y	Y	Y	50	0.53	11	1.96E-05
Methyl mercury	N	N	N	N	0.67	--	0.67	4.94E-04
Mercury (inorganic)	N	N	N	N	0.1	0.1	0.1	2.49E-02
Nickel	N	N	N	N	30	13.6	13.6	4.95E-06
Selenium	N	N	N	N	0.81	0.0276	0.0276	3.14E-06
Silver	N	N	N	N	2	4.04	2	1.45E-02
Thallium	N	N	N	N	1,000	0.0569	0.057	3.65E-03
Zinc	Y	Y	N	N	50	6.62	6.62	9.00E-07

-- not available

Notes:

1. EPA ecological screening level (EPA, 2005b)
2. EPA Region 4 ecological screening values (EPA, 1999b)
3. EPA Region 5 ecological soil screening levels (EPA, 2003)

Table 10-4
Ecological Evaluation: Organics in Surface Water
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

	Puerto Rico Water Quality Standards[1]	Federal Saltwater AWQC[2]	EPA Region 4 ESL[3]	Tier II Benchmarks Freshwater[4]	Other Benchmarks[5]	Selected ESL	Media Concentration ug/L
(Concentration units are in ug/L)							
Acetaldehyde	--	--	--	--	--	49.6	7.85E-06
Acetone	--	--	--	1,500	2.E+04	1,500	7.02E-04
Chloroform	4700	--	815	28	180	4,700	2.96E-04
TCDD,2,3,7,8	--	--	1.00E-05	--	3.80E-06	3.80E-06	2.19E-07
Fluoranthene	370	--	1.6	--	--	1.6	9.54E-07
Formaldehyde	--	--	--	--	49.6	49.6	1.79E-04
Furan	--	--	--	--	--	--	2.70E-10
Methanol	--	--	--	--	--	--	8.17E-04
Methylene Chloride	2.E+04	--	2560	2,200	--	1.60E+04	1.05E-02
PCBs	--	0.03	0.03	0.14	--	0.03	1.30E-05
Propionaldehyde	--	--	--	--	--	--	5.41E-06
Pyrene	--	--	--	--	0.3	0.3	1.44E-06
Toluene	2.E+05	--	37	9.8	--	2.E+05	4.40E-04
Xylene	--	--	--	13	--	13	6.57E-05

-- not available

Notes:

1. Puerto Rico Environmental Quality Board (PREQB, 2003), water quality standards for coastal and estuarine water
2. The EPA ambient water quality criteria for protection of aquatic life in saltwater for continuous exposure (EPA, 2002)
3. EPA Region 4 surface water screening values for saltwater compiled from various water quality criteria documents (EPA, 2001b)
4. Oak Ridge National Laboratory (ORNL, 1996) Tier II benchmarks
5. Reference values from Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, 1999c)
   No saltwater value for TCDD,2,3,7,8- was available. The value provided is for freshwater toxicity.
   The value used for formaldehyde is a for freshwater toxicity for formalin
   The value for pyrene is from EPA Region 5 Ecological Screening Levels

Table 10-5
Ecological Evaluation: Metals in Surface Water
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

	Puerto Rico Water Quality Standards[1]	Federal Saltwater AWQC[2]	EPA Region 4 ESL[3]	Tier II Benchmarks Freshwater[4]	Other Benchmarks[5]	Selected ESL	Media Concentration ug/L
(Concentration units are in ug/L)							
Antimony	4300	--	--	30	0.5	4300	6.90E-05
Arsenic	1.4	36	36	--	36	36	2.36E-06
Barium	--	--	--	4	5	4	4.70E-05
Beryllium	--	--	--	0.66	0.66	0.66	1.28E-06
Cadmium	9.3	8.8	9.3	--	9.3	8.8	1.29E-06
Chromium (+3)	--	--	103	--	--	103	1.55E-04
Lead	8.1	8.1	8.5	--	8.1	8.1	9.18E-06
Mercury	0.051	0.94	0.025	1.3	0.94	0.051	6.33E-05
Nickel	8.2	8.2	8.3	--	8.2	8.2	3.21E-05
Selenium	71	71	71	--	71	71	1.03E-04
Silver	2	--	0.23	0.36	0.23	2	4.97E-04
Thallium	--	--	21.3	12	20	21.3	1.22E-05
Zinc	81	81	86	--	81	81	6.13E-06

-- not available

Notes:

1. Puerto Rico Environmental Quality Board (PREQB, 2003) water quality standards for coastal and estuarine water
2. The EPA ambient water quality standards for protection of aquatic life in saltwater for continuous exposure (EPA, 2002)
3. EPA Region 4 surface water screening values for saltwater compiled from various water quality criteria documents (EPA, 2001b)
4. Oak Ridge National Laboratory (ORNL, 1996) Tier II benchmarks
5. Toxicity reference values from Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA, 1999c)

Table 10-6
Ecological Evaluation: Organics in Sediment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

	NOAA TEL[1]	EPA Region 4 Benchmark[2]	EPA Ecotox Threshholds[3]	EPA Region 5 ESLs[4]	Selected ESL	Media Concentration ug/kg
(Concentration units are in ug/kg)						
Acetaldehyde	--	--	--	--	--	1.57E-07
Acetone	--	--	--	9.9	9.9	1.40E-05
Chloroform	--	--	--	121	121	6.22E-04
Dioxin (ng/kg)	--	2.5	--	--	2.5	1.82E-05
Fluoranthene	112.82	330	--	423	112.82	1.87E-03
Formaldehyde	--	--	--	--	--	1.61E-05
Furan	--	--	--	--	--	9.27E-05
Methanol	--	--	--	--	--	5.72E-06
Methylene Chloride	--	--	--	--	--	4.21E-03
PCBs	21.5	33	--	59.8	21.5	1.93E-06
Propionaldehyde	--	--	--	--	--	8.66E-07
Pyrene	152.66	330	--	195	152.66	3.91E-03
Toluene	--	--	--	1220	1220	2.46E-03
Xylene	--	--	25	433	25	5.15E-04

-- not available
TEL-Threshhold Effects Level
Notes:
1. National Oceanic and Atmospheric Administration screening values for marine sediment (NOAA, 1999)
2. EPA Region 4 sediment screening values for hazardous waste sites (EPA, 2001b)
3. EPA Ecotox Threshholds (EPA, 1996)
4. EPA Region 5 Ecological Screening Levels for sediment (EPA, 2003)
Concentration units are in ug/kg for all compounds except for Dioxin which is in ng/kg

Table 10-7
Ecological Evaluation: Metals in Sediment
TAPI Puerto Rico Inc.
Guayama, Puerto Rico

	NOAA TEL[1]	EPA Region 4 Benchmark[2]	EPA Ecotox Thresholds[3]	EPA Region 5 ESLs[4]	Selected ESL	Media Concentration mg/kg
(Concentrations are in mg/kg)						
Antimony	--	12	--	--	12	2.09E-06
Arsenic	7.2	7.24	8.2	9790	7.2	4.47E-08
Barium	--	--	--	--	--	8.39E-07
Beryllium	--	--	--	--	--	6.65E-07
Cadmium	0.676	1	1.2	990	0.676	6.31E-08
Chromium (+3)	52.3	52.3	81	4.34E+04	52.3	1.19E-06
Lead	30.2	30.2	47	3.58E+04	30.2	5.42E-06
Mercury	0.13	0.13	0.15	0.174	0.13	3.54E-04
Nickel	15.9	15.9	21	2.27E+04	15.9	1.37E-06
Selenium	--	--	--	--	--	3.37E-07
Silver	0.73	0.73	--	500	0.73	1.61E-06
Thallium	--	--	--	--	--	4.16E-07
Zinc	124	124	150	1.21E+05	124	2.49E-07

-- not available
TEL-Threshhold Effects Level
Notes:
1. National Oceanic and Atmospheric Administration screening values for marine sediment (NOAA, 1999)
2. EPA Region 4 sediment screening values for hazardous waste sites (EPA, 2001b)
3. EPA Ecotox Threshholds (EPA, 1996)
4. EPA Region 5 Ecological Screening Levels for sediment (EPA, 2003)

Figures

Scale	Date
None	Nov 2006

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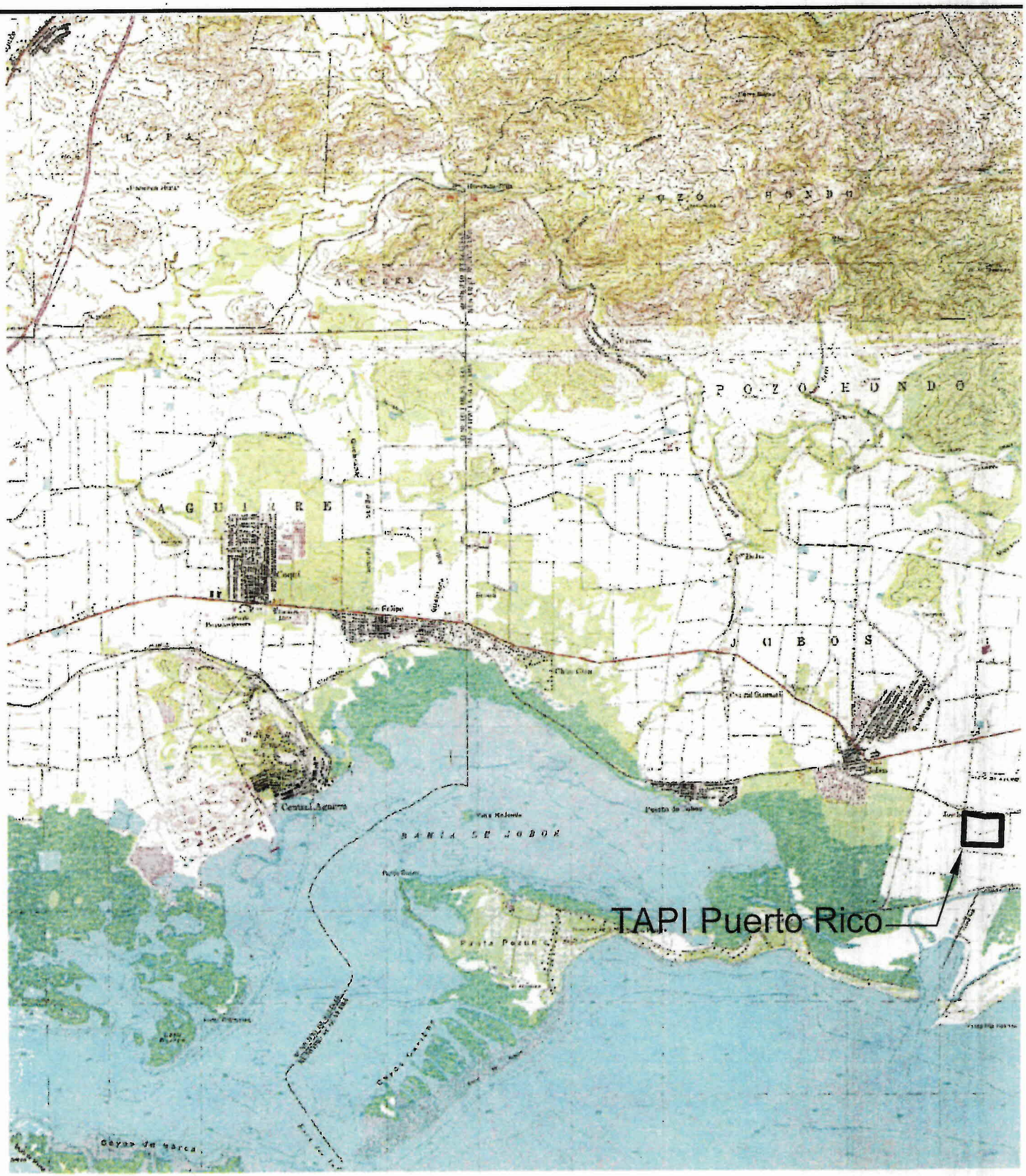
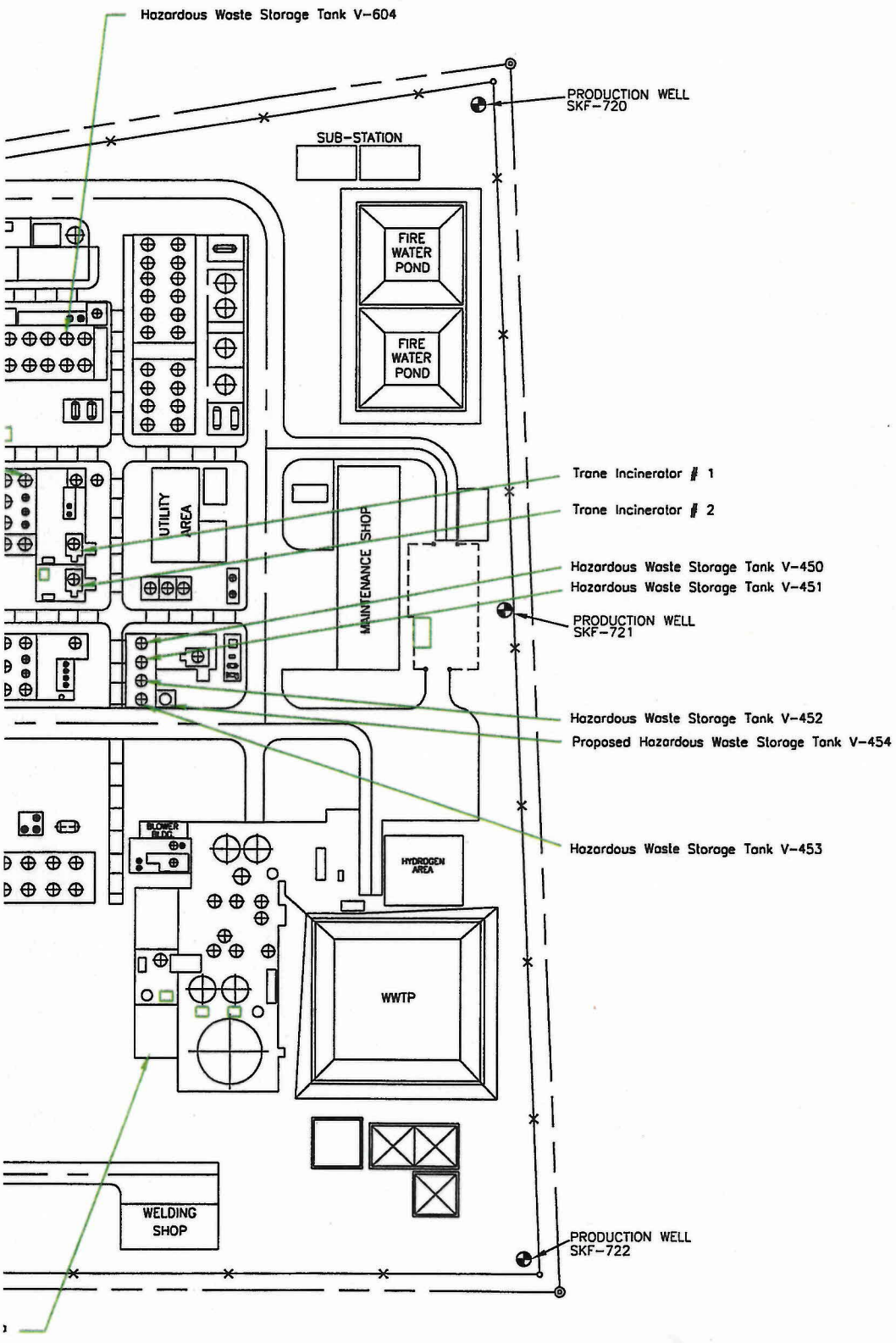
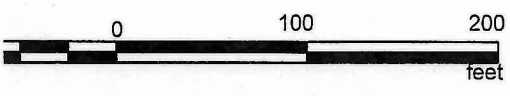
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 2-1
Facility Location Map

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico


TAPI Puerto Rico





Scale	Date
1/100	Nov 2006

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WHITE PLAINS, NEW YORK
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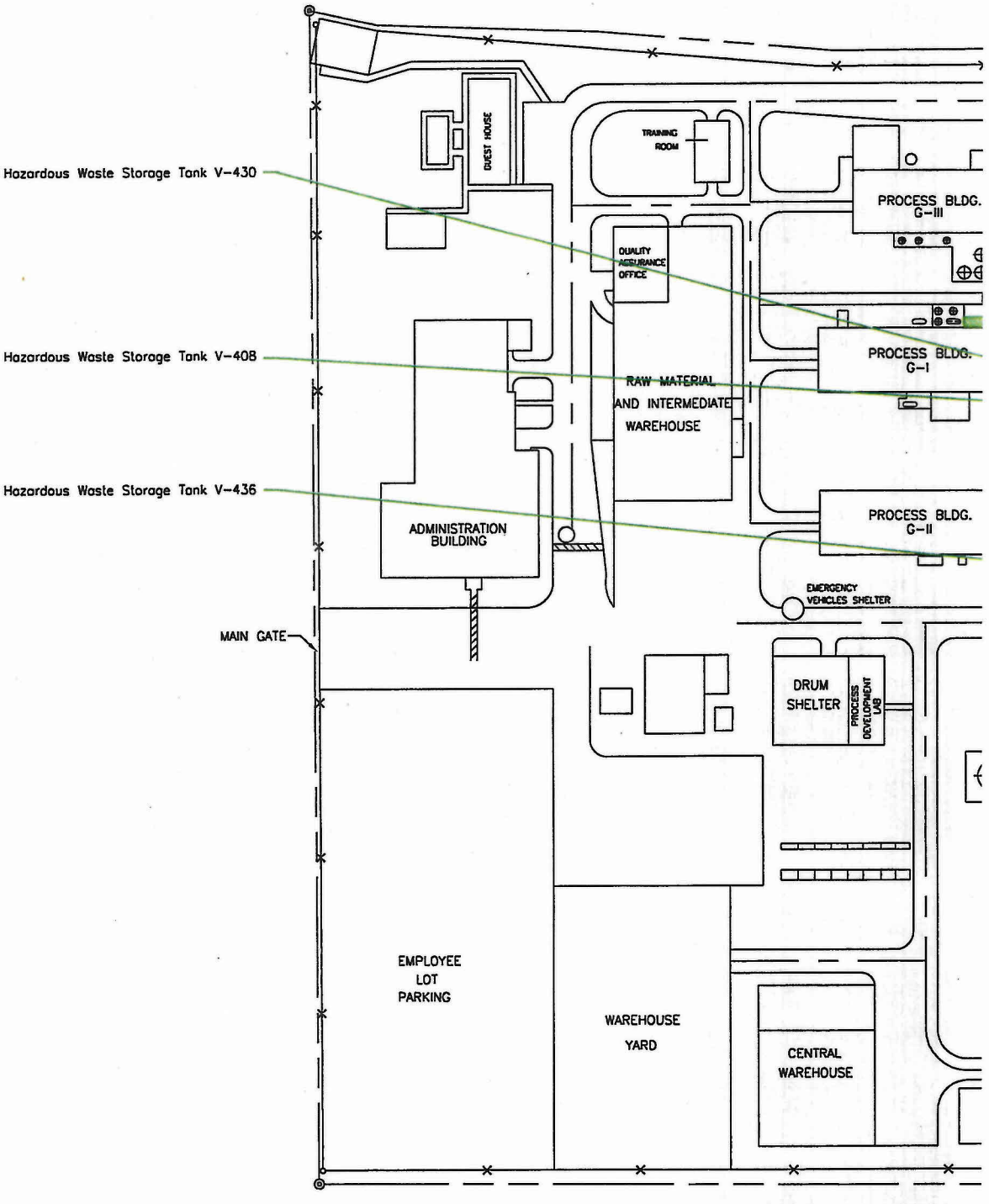
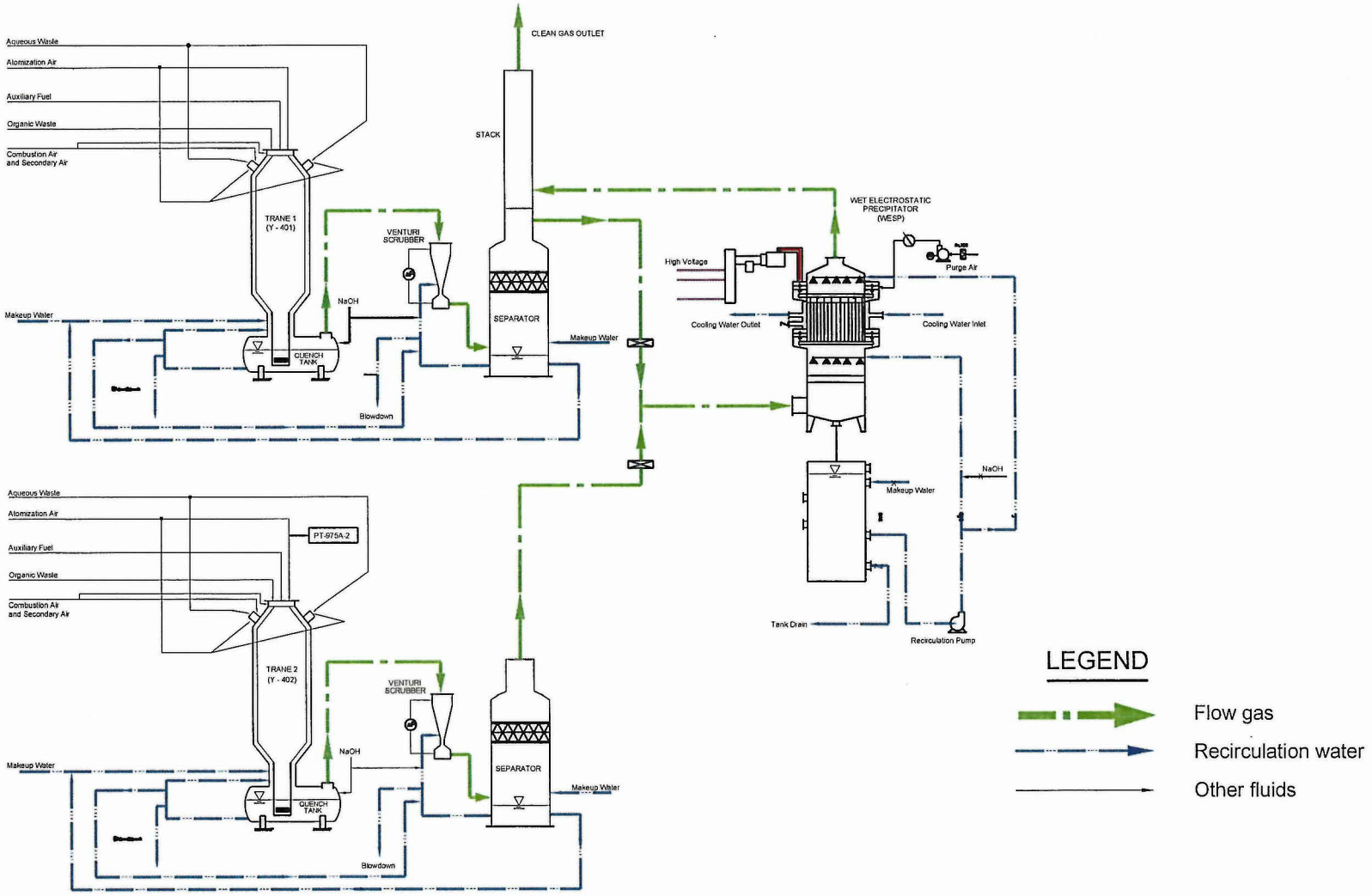
Figure 2-2
Facility Site Map

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



Hazardous Waste Container Stor



Scale	Date
None	Nov 2006

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WHITE PLAINS, NEW YORK
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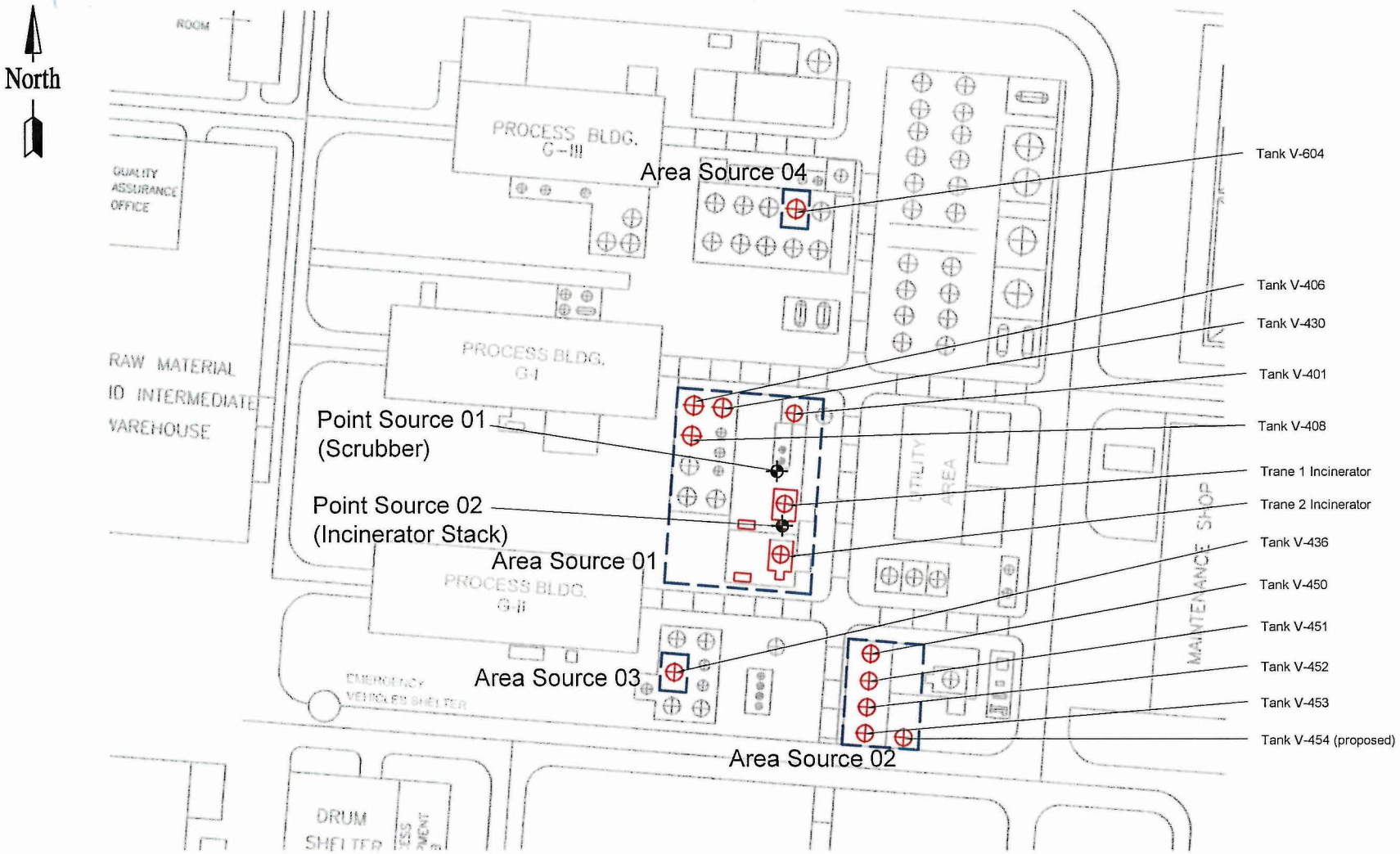
Figure 2-3

TRANE 1 AND TRANE 2 INCINERATORS PROCESS FLOW DIAGRAM

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



NOTE

1. Emissions from tanks are coveyed to the scrubber (Point source 01) via an exhausting piping system.

2. The emissions center of all sources has been located at the middle point of a line connecting the stack and scrubber (Point source 01 and Point source 02. The UTM coordinates of the emission center are X:801476 and Y:1986909

Scale	Date
not scaled	Nov 2006

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Figure 2-4
Locations of Emission Sources

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico

NOTE

Grid Type :
Multi-tier Cartesian based on NAD 27 USGS 7.5 minute topographic maps.

Grid Center :
Middle point of a line connecting the stack and scrubber. The UTM coordinates are X:801476 and Y:1986909

Grid Elevations :
Obtained from U.S. Geological Survey (USGS) NAD 27 1:24,000-Scale Raster Profile Digital Elevations. DEM files were obtained for Cayey, Central Aguirre, Guayama, and Patillas quadrangles to cover an area of 10 Km radius from the grid center.

Grid Array :
25 m grid spacing from grid center out to 500 m
100 m grid spacing from 500 m out to 3 km
500 m grid spacing from 3 km out to 10 km

Scale	Date
Indicated	Nov 2006

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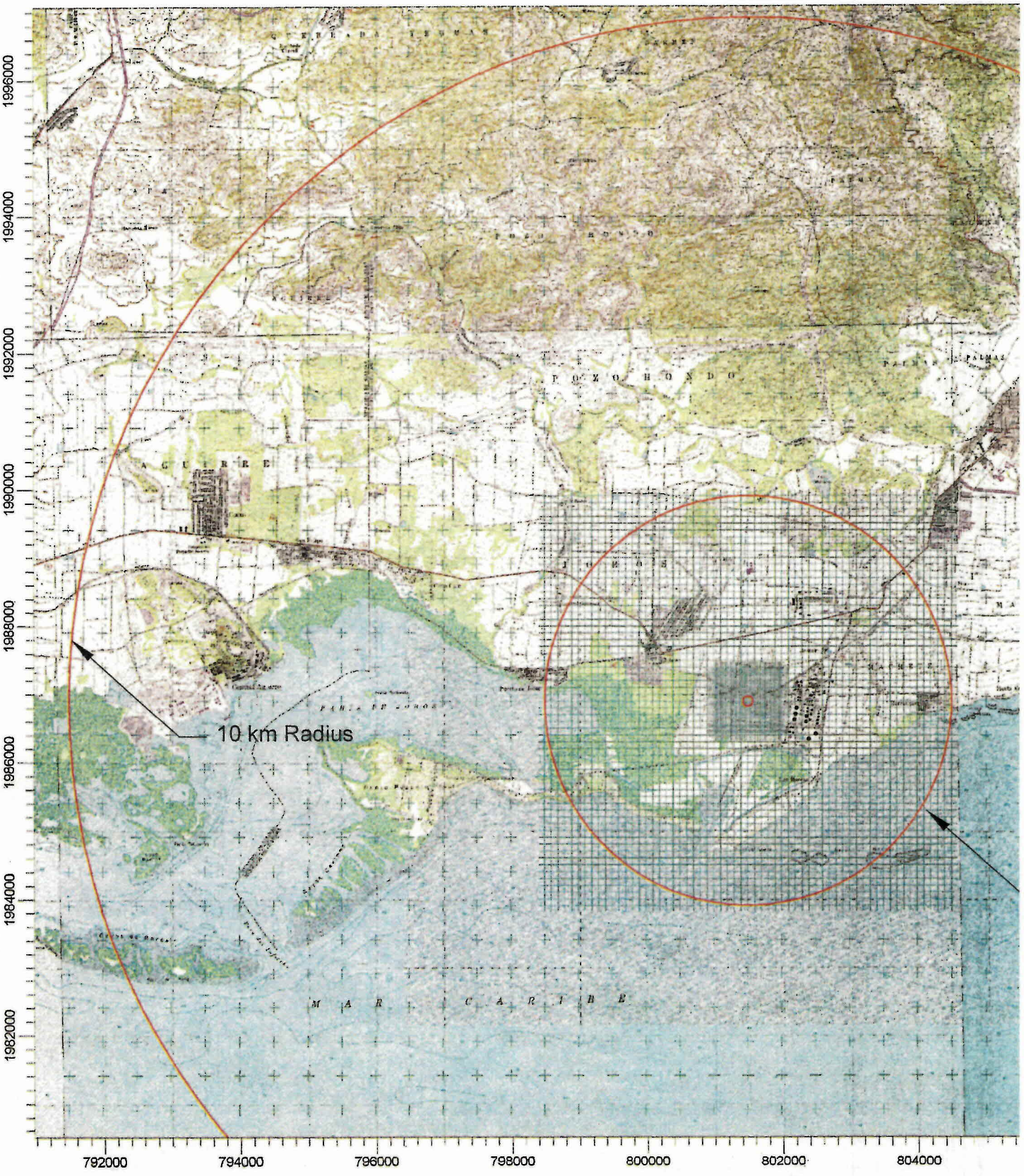
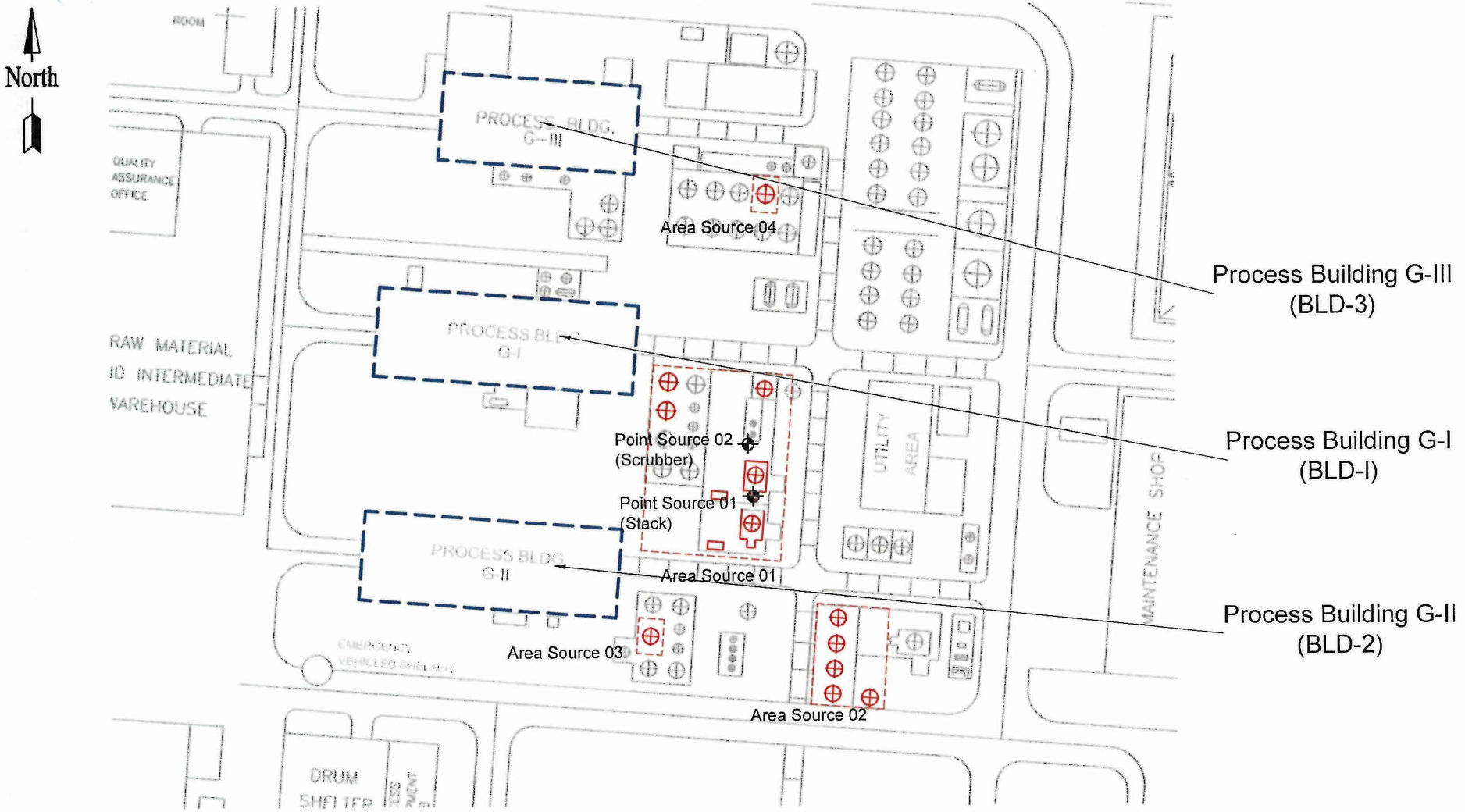
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 3-1
Receptor Grid Array

TAPI Puerto Rico, Inc.
Guayama, puerto Rico


10 km Radius
1996000
1994000
1992000
1990000
1988000
1986000
1984000
1982000
792000
794000
796000
798000
800000
802000
804000
P O Z O H O N D O
M A R C A R I B E



Scale	Date
not scaled	Nov 2006

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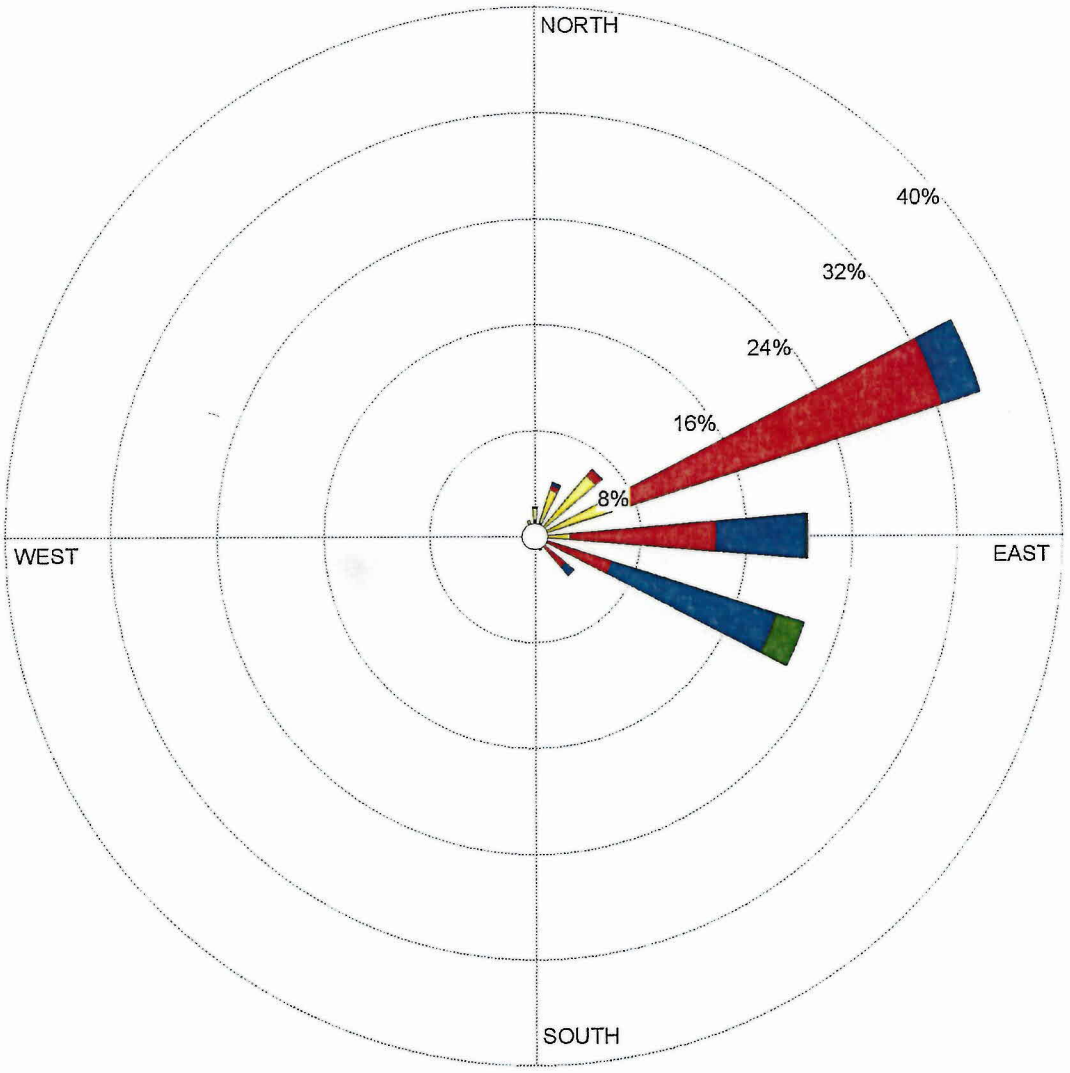
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 3-2
Source and Building Locations

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



Scale	Date
not scaled	Nov 2006

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WHITE PLAINS, NEW YORK
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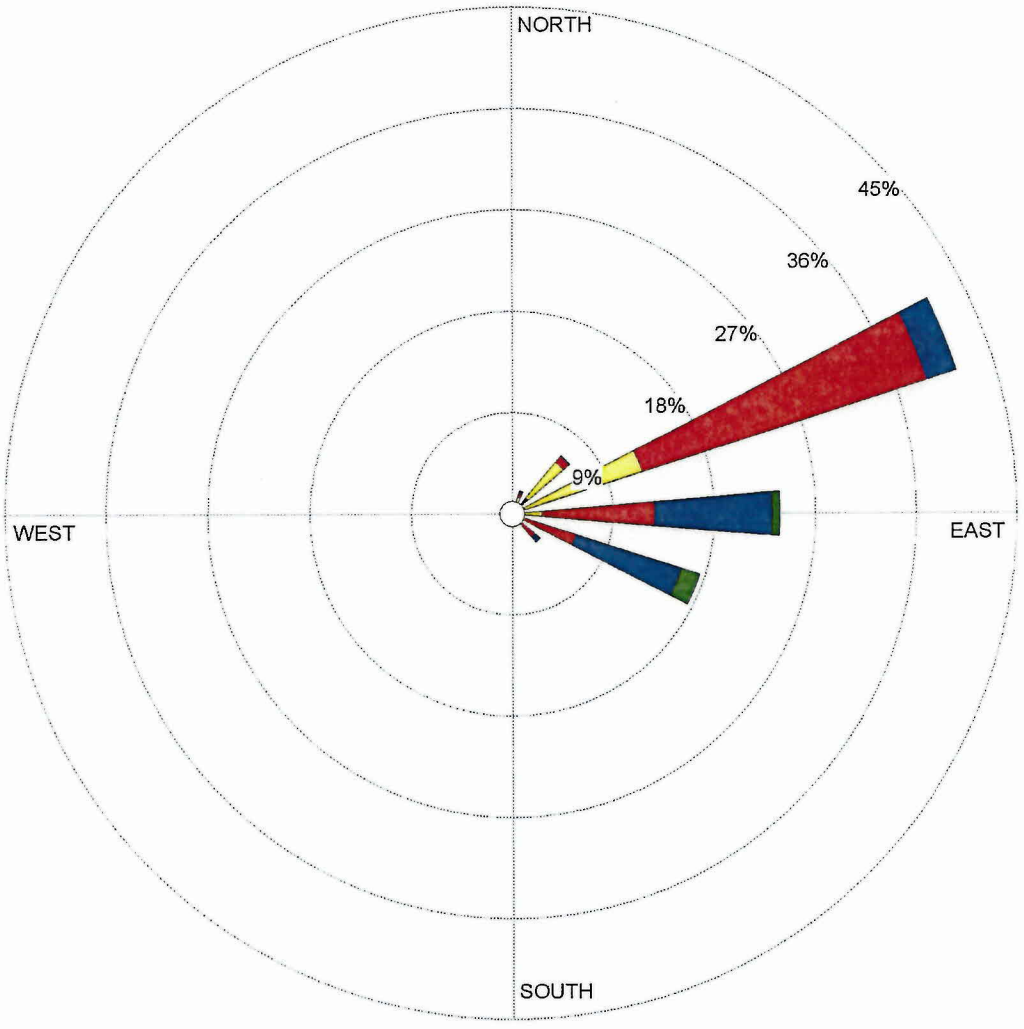
Figure 3-3
Wind Rose, 10 meter height

TAPI Puerto Rico, Inc
Guayama, Puerto Rico



Scale	Date
not scaled	Nov 2006

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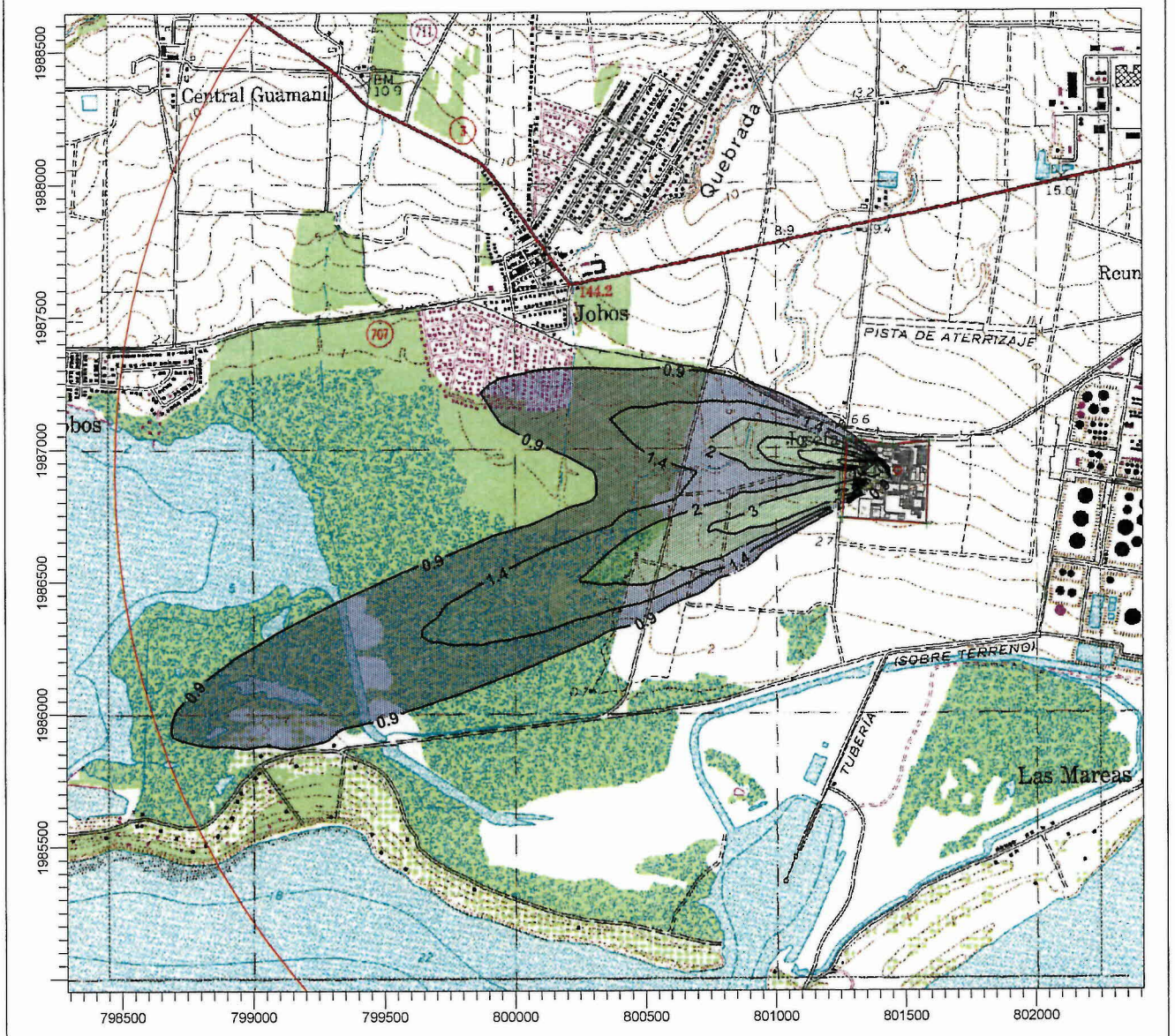
Figure 3-4
Wind Rose, 50 meter height

TAPI Puerto Rico, Inc
Guayama, Puerto Rico

Figure 3-5. Stack - Vapor Phase Ambient Air Concentration Isopleth Map



Vapor Phase Concentration, Unitized ug/m^3

1 1 2 3 4 5 6 7 8

COMMENTS:	COMPANY NAME: TAPI Puerto Rico, Inc.	
OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
	DATE: 11/22/2006	PROJECT NO.:

ISC-AERMOD View - Lakes Environmental Software

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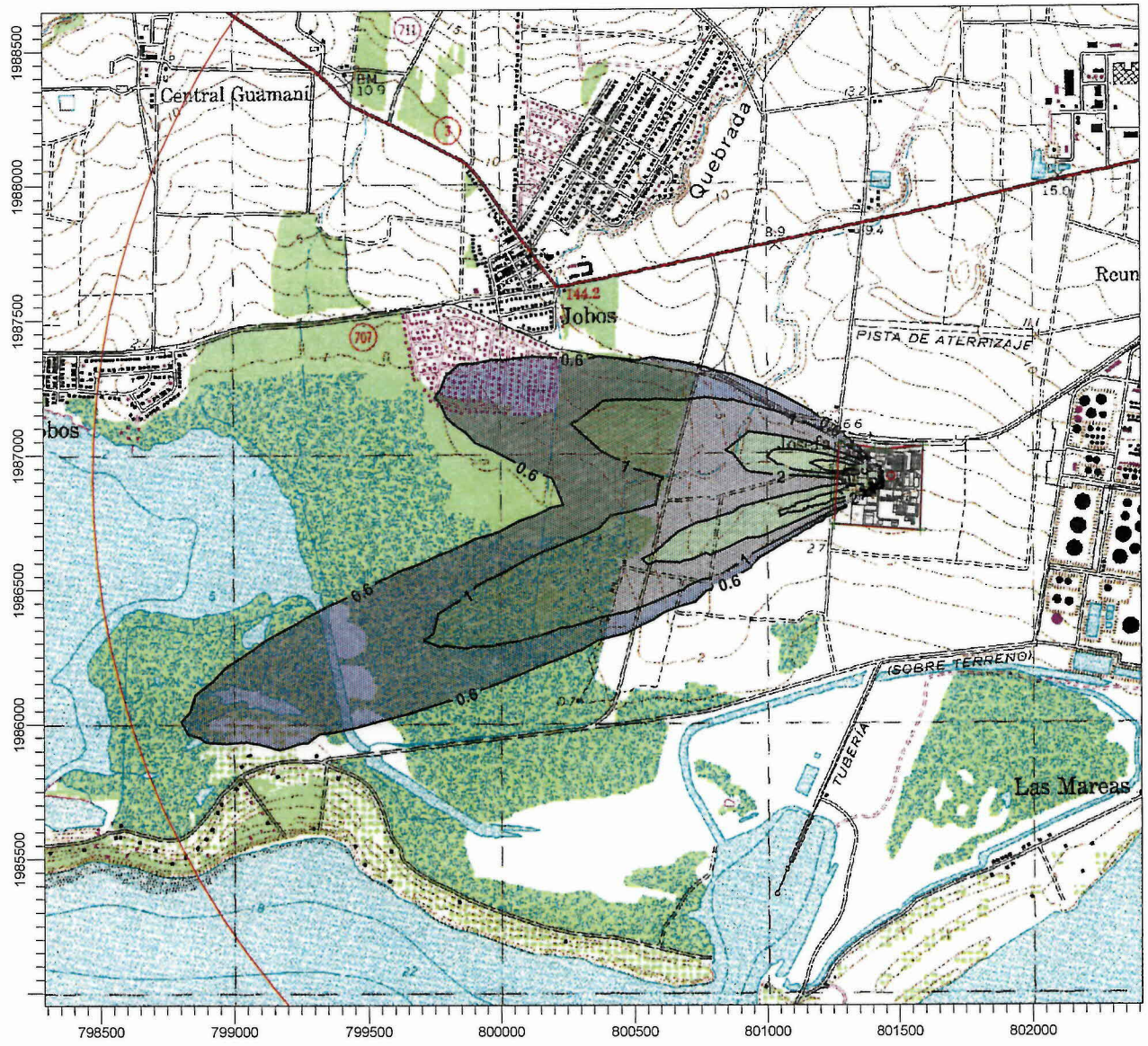
Figure 3-6. Stack - Vapor Phase Ambient Air Concentration Isopleth Map for Mercury

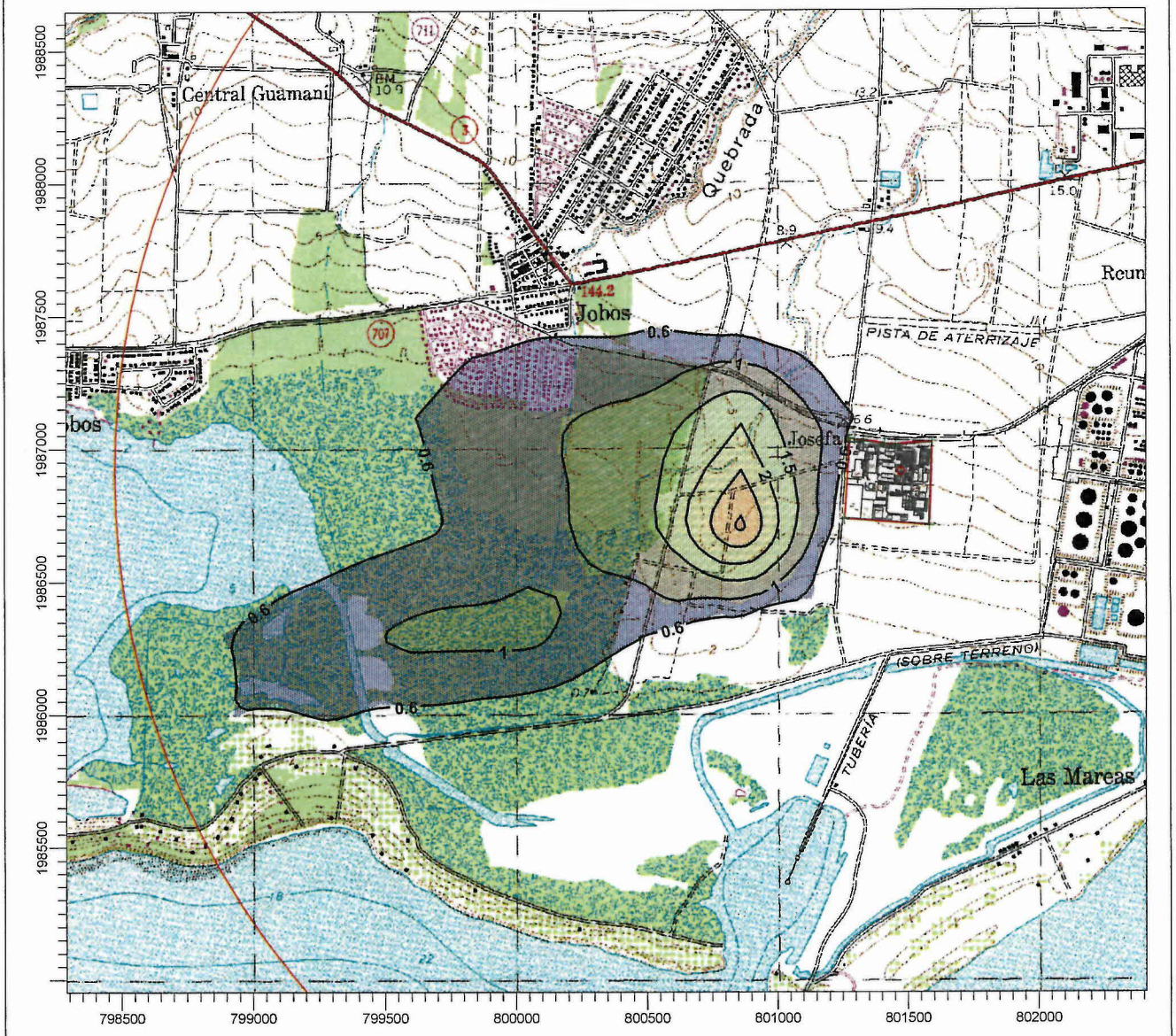


Vapor Phase Concentration, Unitized — ug/m^3

1 | 1 | 2 | 3 | 4 | 5 | 6 | 7

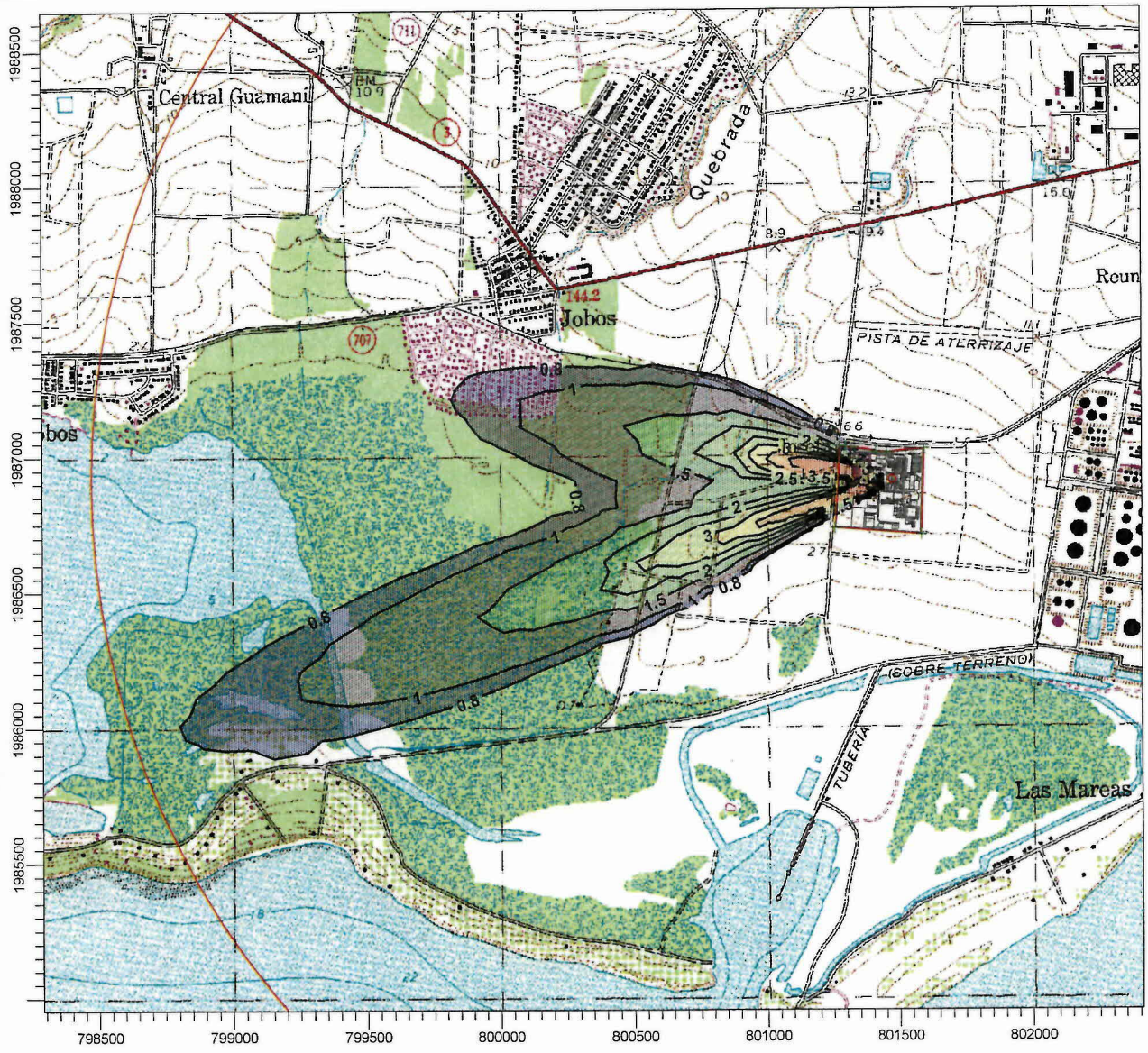
COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-7. Stack - Particle Phase Ambient Air Concentration Isopleth Map



COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-8. Stack – Particle-Bound Phase Ambient Air Concentration Isopleth Map

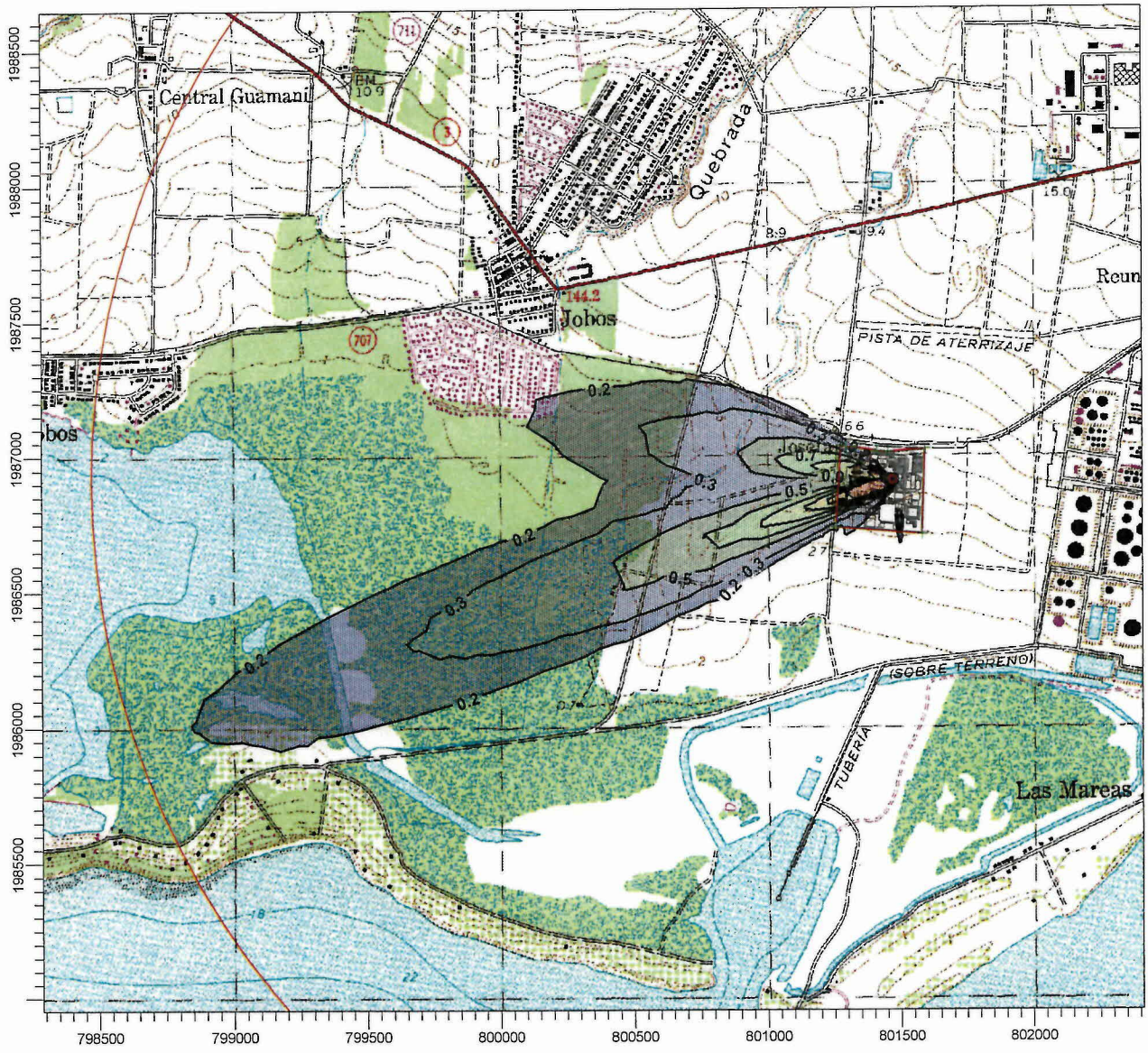


Particle-Bound Phase Concentration, Unitized ug/m^3

1 1 2 2 3 3 4 4

COMMENTS:	COMPANY NAME: TAPI Puerto Rico, Inc.	
OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
	DATE: 11/22/2006	PROJECT NO.:

Figure 3-9. Stack - Vapor Phase Total Deposition Isopleth Map



Total Deposition Rate, Unitized — g/m^2

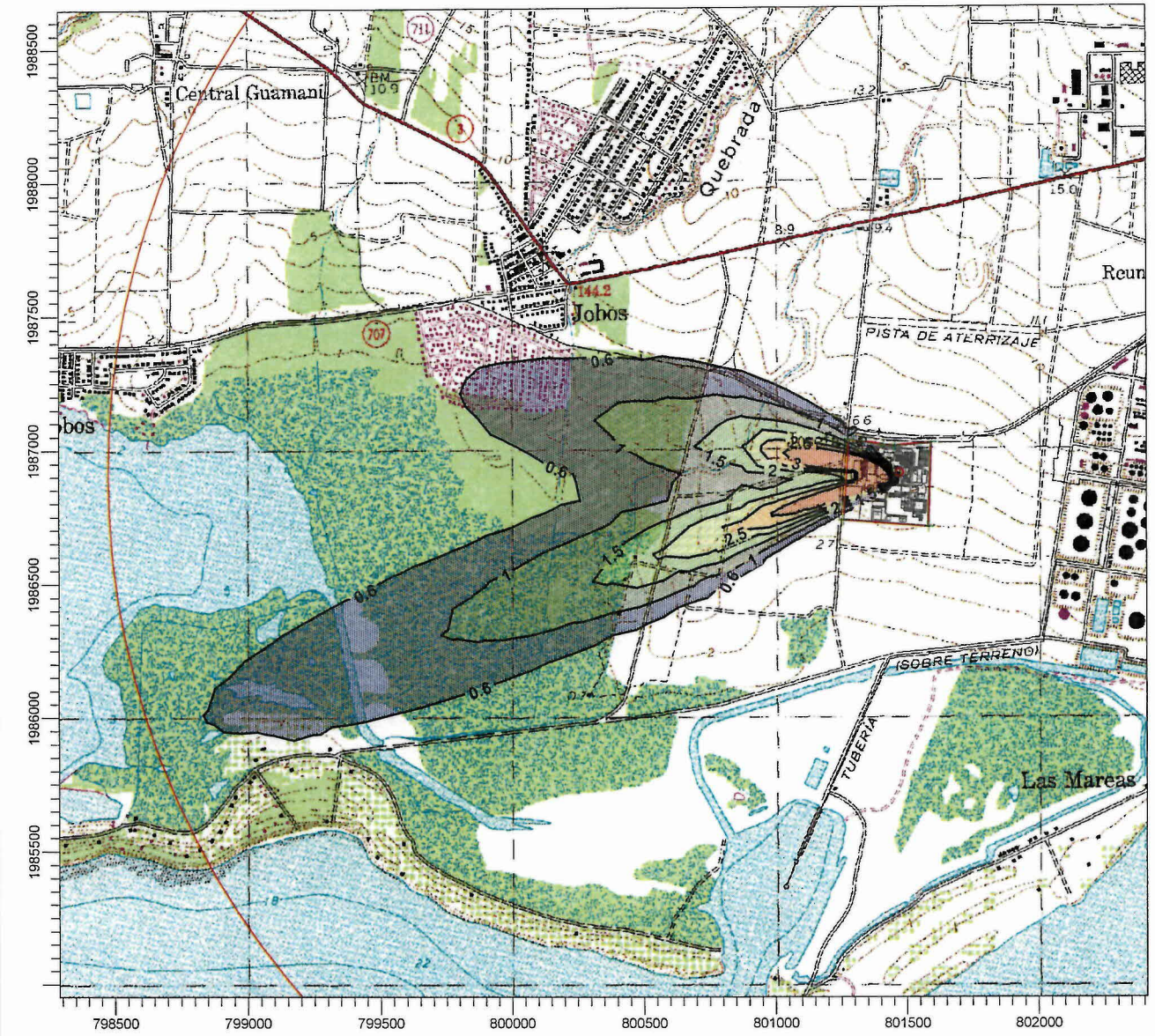
0.2 | 0.3 | 0.5 | 0.7 | 0.9 | 1.1 | 1.3 | 1.5

COMMENTS:	COMPANY NAME: TAPI Puerto Rico, Inc.	
OUTPUT TYPE: Total Depos.	SCALE: 1:25,000 (0 — 0.5 km)	
	DATE: 11/22/2006	PROJECT NO.:

ISC-AERMOD View - Lakes Environmental Software

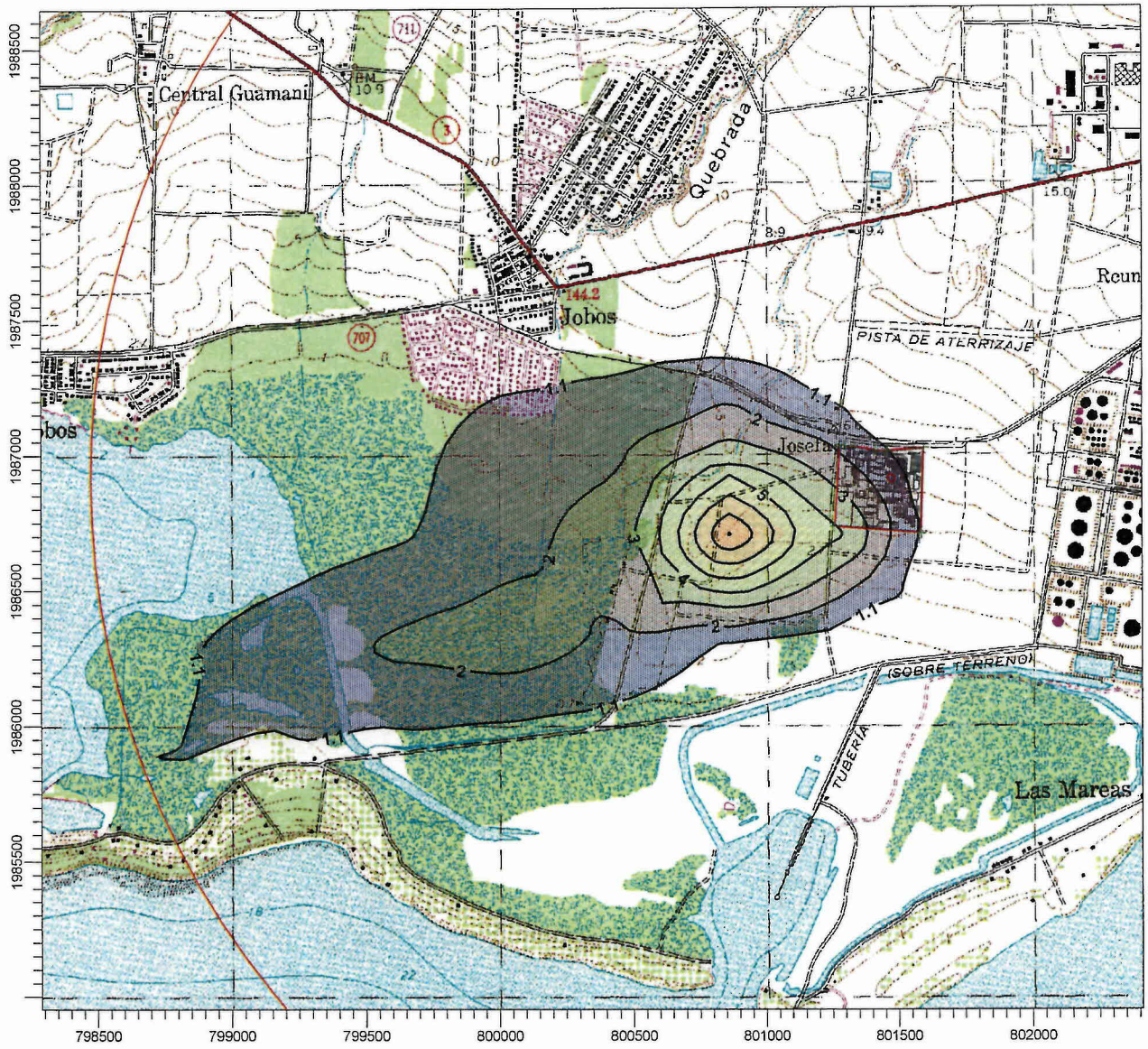
C:\PROJECTS\API\Risk Assessment\ISC-AERMODE\TAPI-ISC-AERMODE\API.isc

Figure 3-10. Stack - Vapor Phase Total Deposition Isopleth Map for Mercury



COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Total Depos.	SCALE: 1:25,000 0 0.5 km	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-11. Stack - Particle Phase Total Deposition Isopleth Map



Total Deposition Rate, Unitized g/m^2

1.1 2.0 3.0 4.0 5.0 6.0 7.0 8.0

COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Total Depos.	SCALE: 1:25,000 0 0.5 km	
		DATE: 11/22/2006	PROJECT NO.:

ISC-AERMOD View - Lakes Environmental Software

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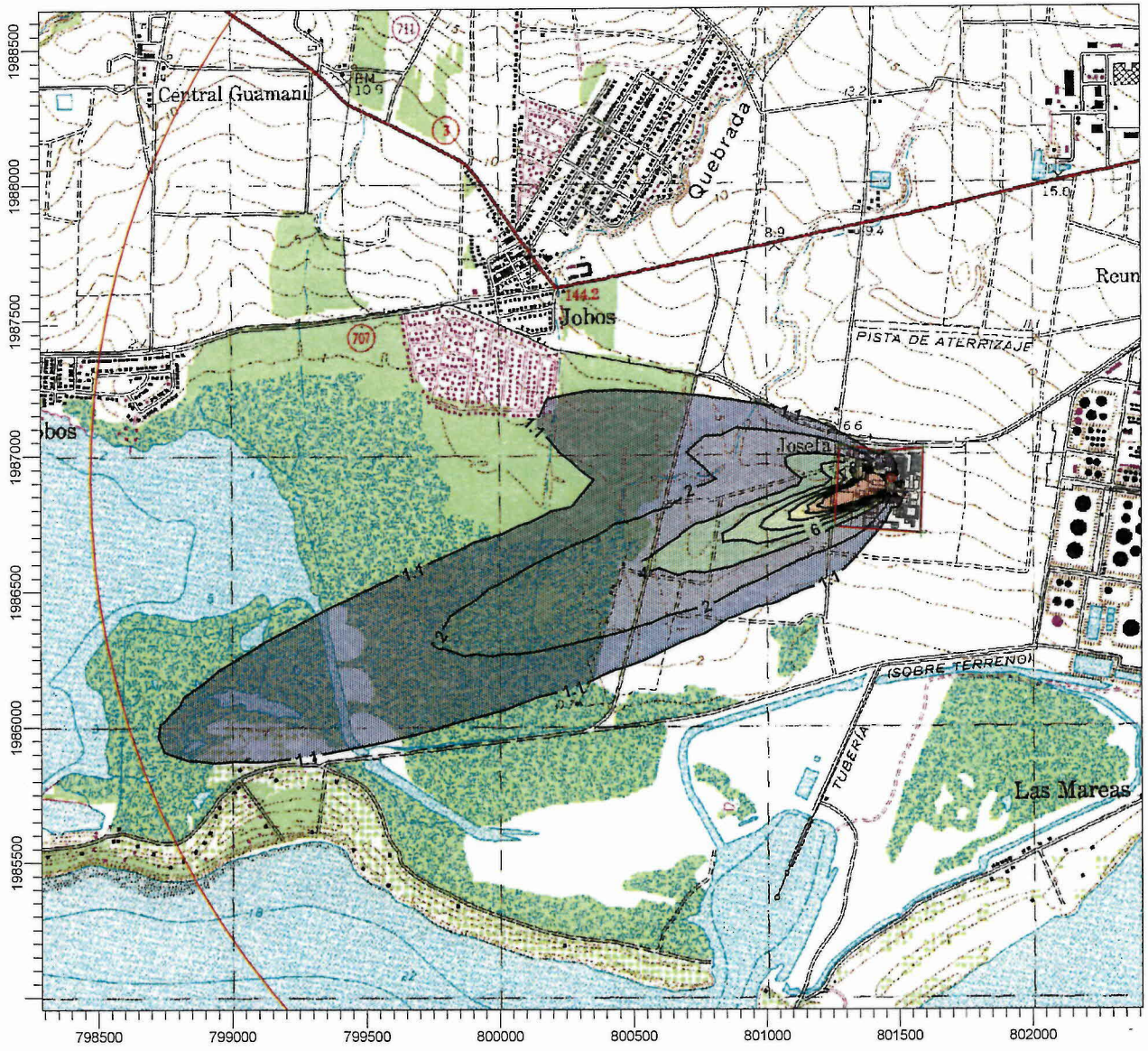
Figure 3-12. Stack - Particle-Bound Phase Total Deposition Isopleth Map

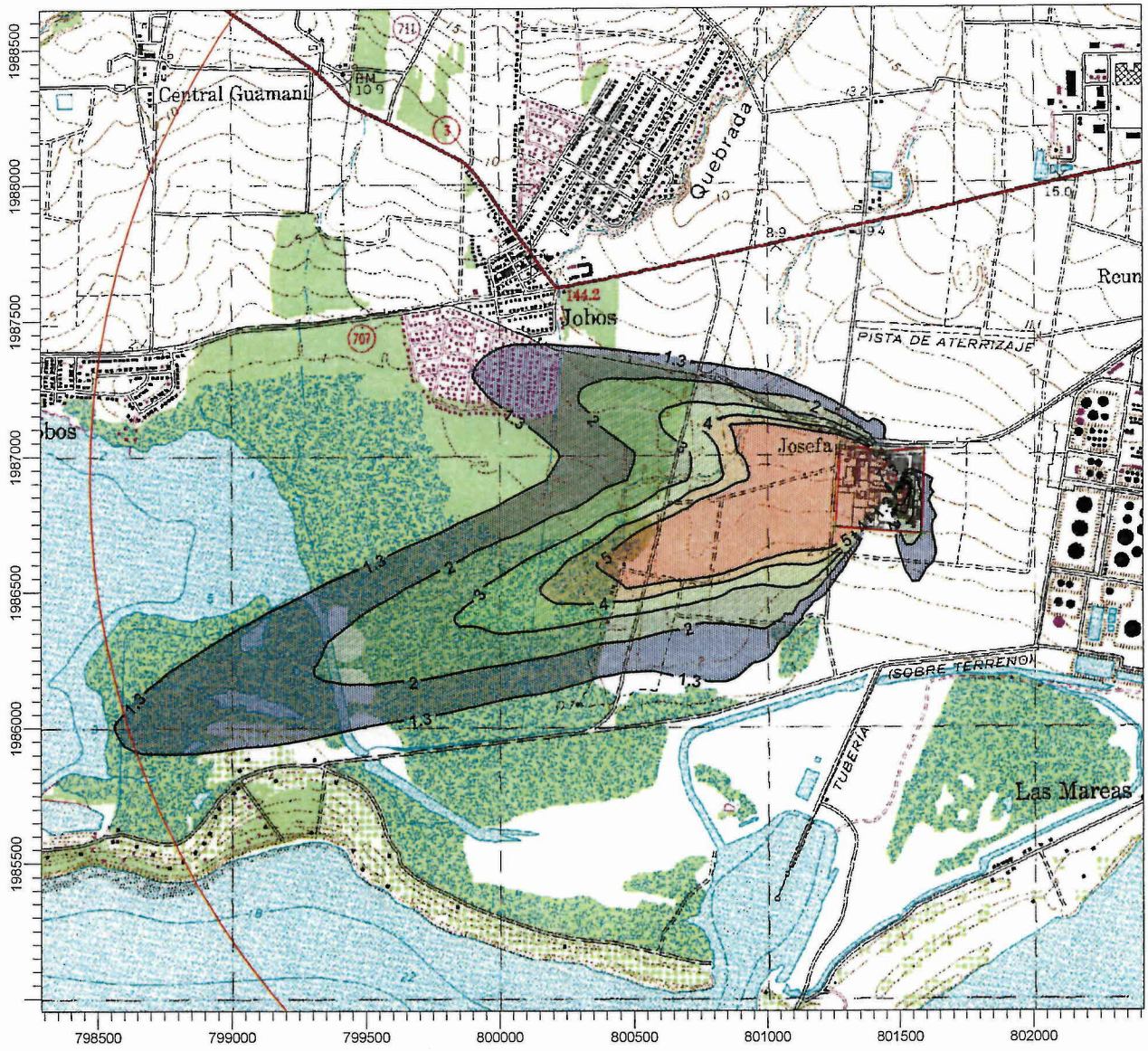


Total Deposition Rate, Unitized g/m^2

1 2 4 6 8 10 12 14

COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Total Depos.	SCALE: 1:25,000 0 0.5 km	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-13. Scrubber - Vapor Phase Ambient Air Concentration Isopleth Map



Vapor Phase Concentration, Unitized — ug/m^3

1 2 3 4 5

COMMENTS:	COMPANY NAME: TAPI Puerto Rico, Inc.	
OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
	DATE: 11/22/2006	PROJECT NO.:

ISC-AERMOD View - Lakes Environmental Software

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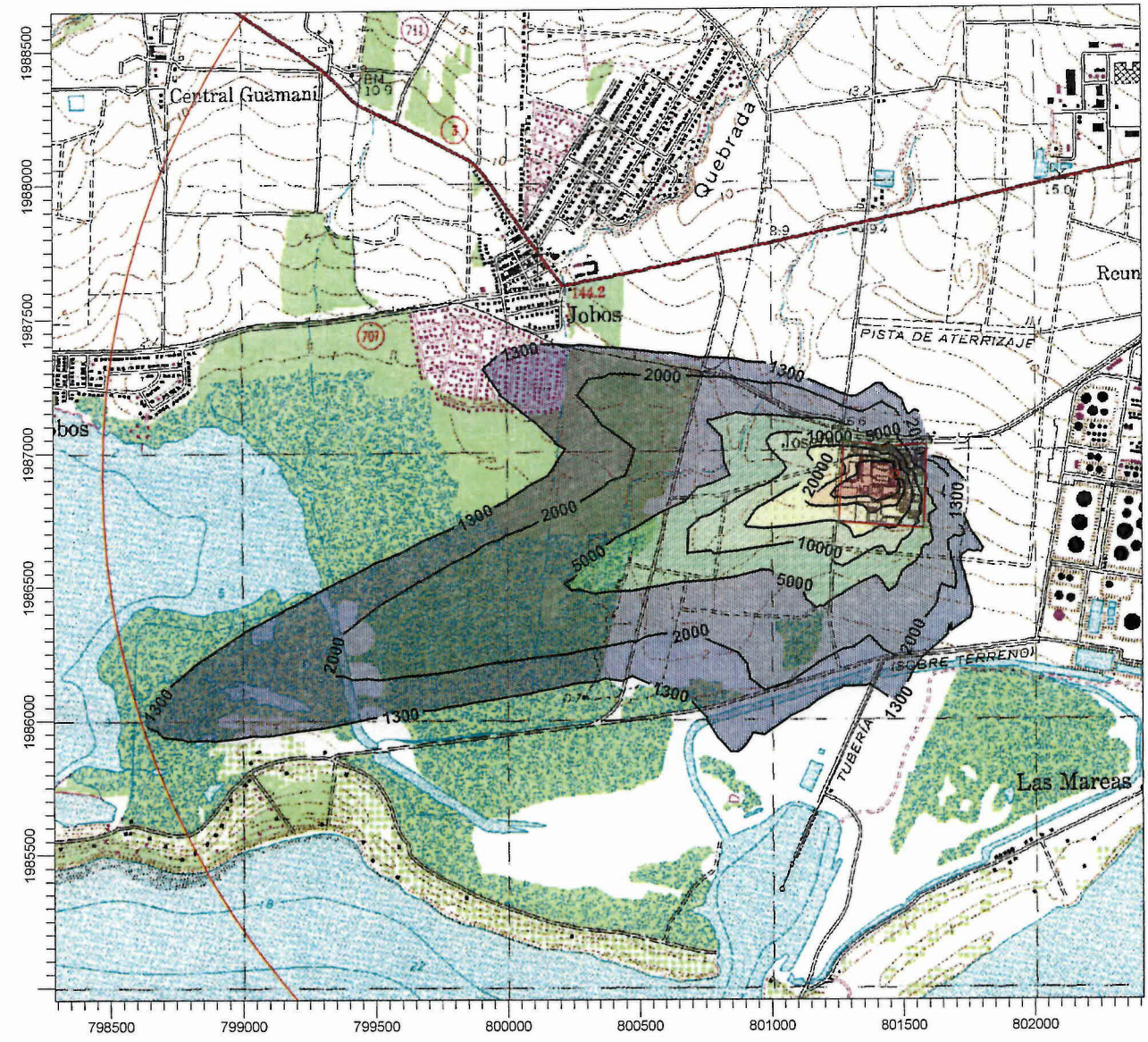
Figure 3-14. Area 1 - Vapor Phase Ambient Air Concentration Isopleth Map

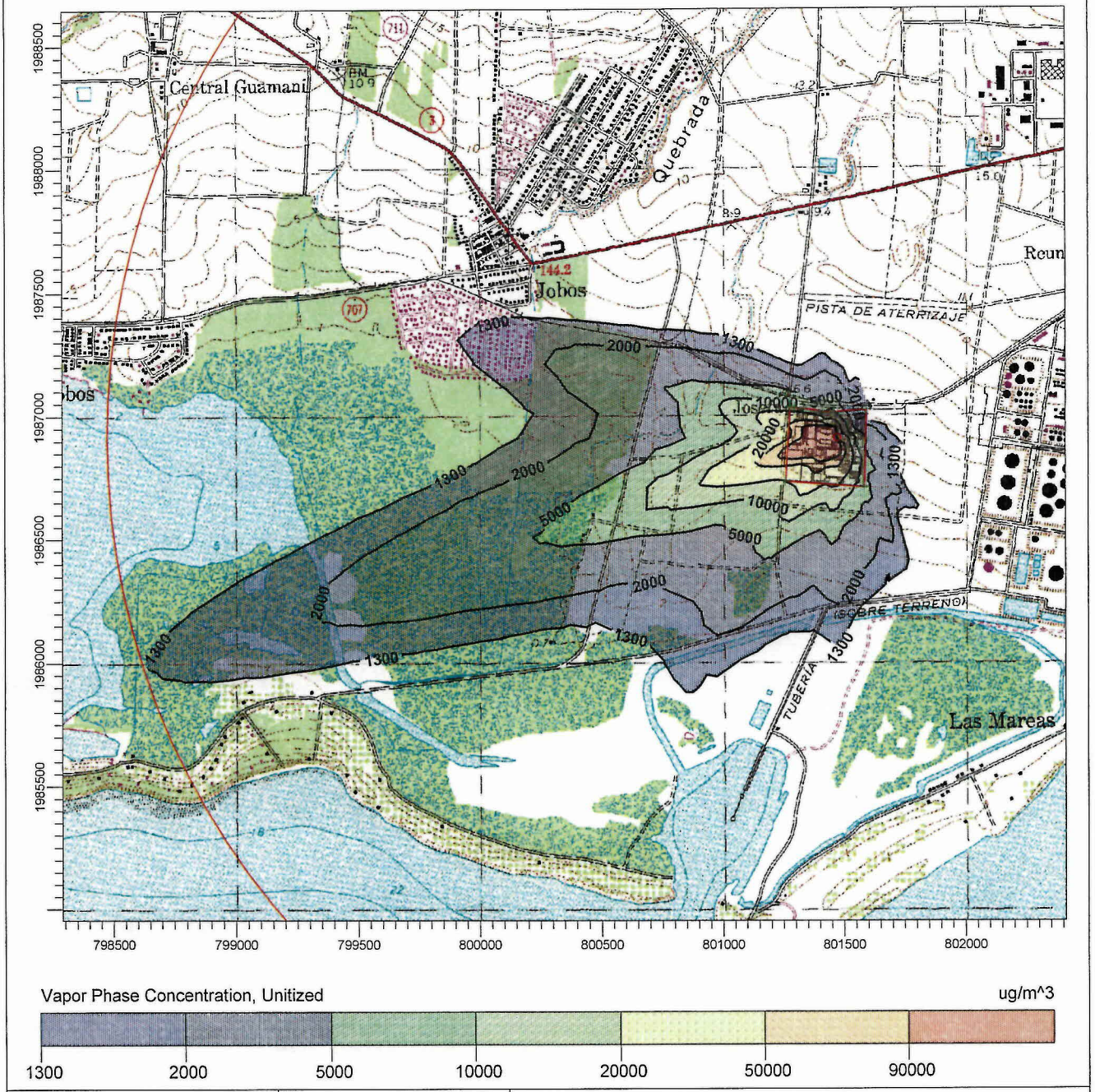


Vapor Phase Concentration, Unitized — ug/m^3

1300 | 2000 | 5000 | 10000 | 20000 | 50000 | 90000

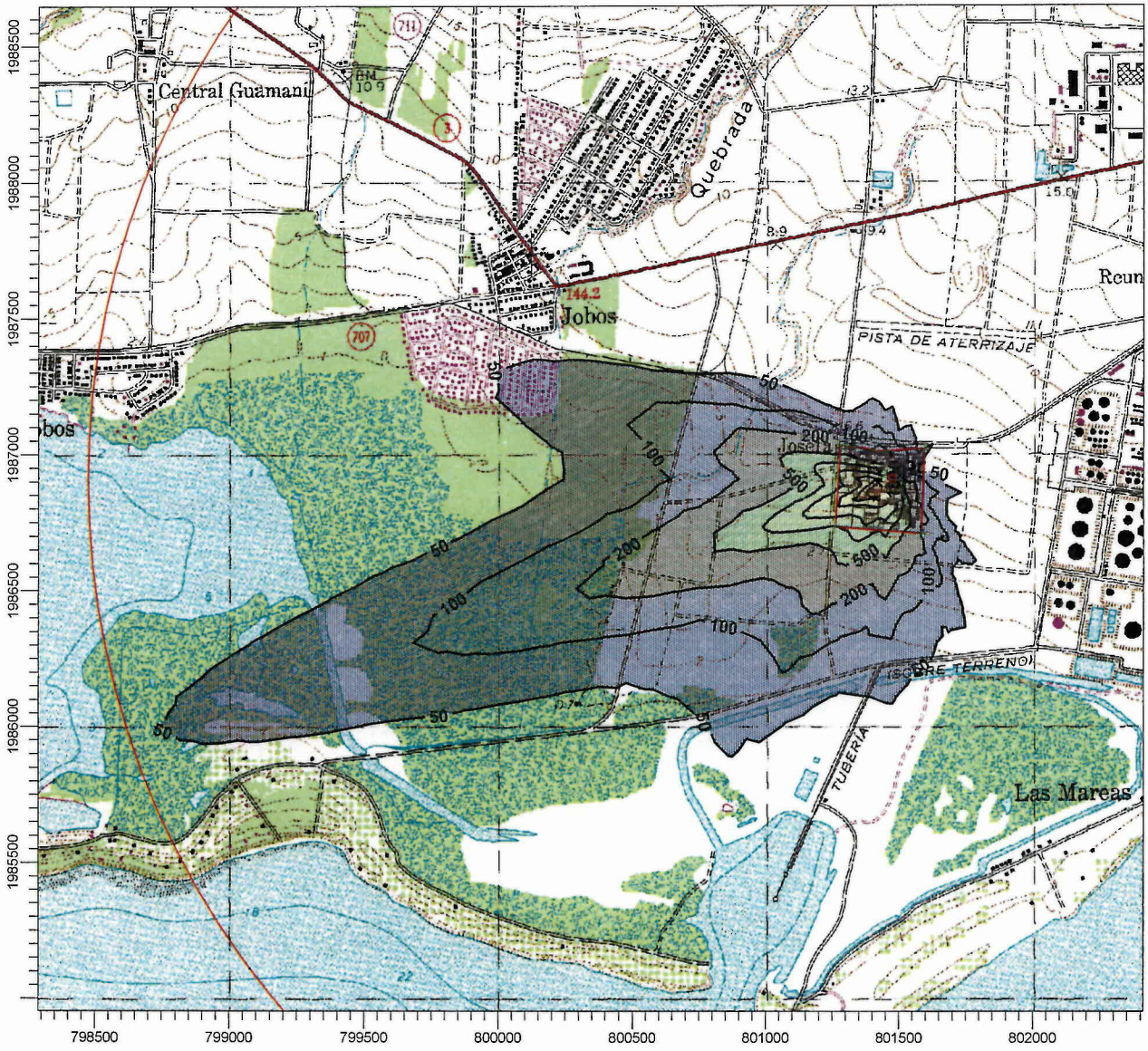
COMMENTS:	COMPANY NAME: TAPI Puerto Rico, Inc.	
OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
	DATE: 11/22/2006	PROJECT NO.:

Figure 3-15. Area 2 - Vapor Phase Ambient Air Concentration Isopleth Map



COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Concentration	SCALE: 1:25,000 0 0.5 km	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-16. Area 3 - Vapor Phase Ambient Air Concentration Isopleth Map

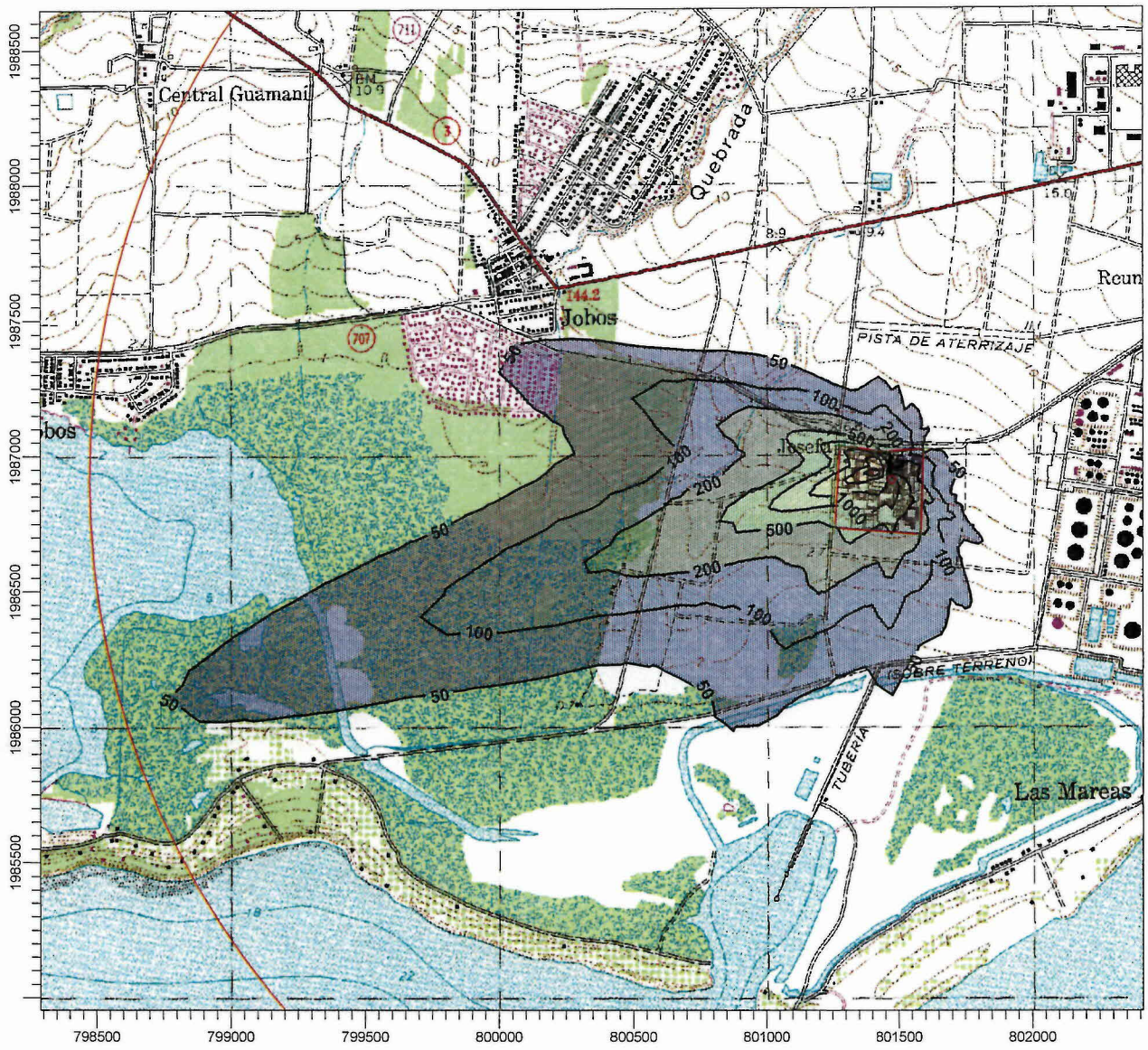


Vapor Phase Concentration, Unitized — ug/m^3

50 100 200 500 1000 2000 5000 10000 20000 40000

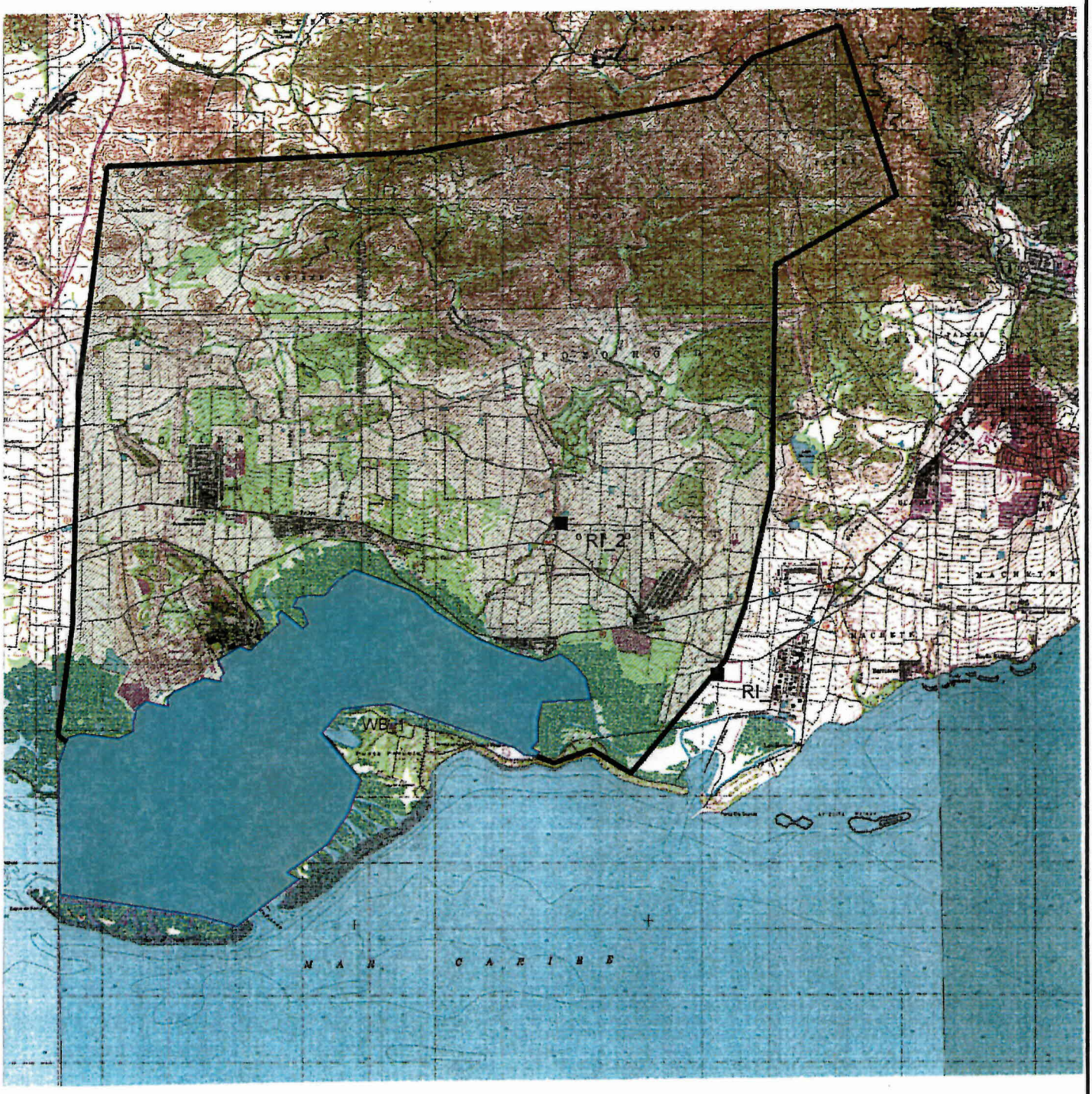
COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
		DATE: 11/22/2006	PROJECT NO.:

Figure 3-17. Area 4 - Vapor Phase Ambient Air Concentration Isopleth Map



Vapor Phase Concentration, Unitized — ug/m^3

COMMENTS:		COMPANY NAME: TAPI Puerto Rico, Inc.	
	OUTPUT TYPE: Concentration	SCALE: 1:25,000 (0 — 0.5 km)	
		DATE: 11/22/2006	PROJECT NO.:



LEGEND

- Receptor Locations
- Watershed Boundary

Scale	Date
None	Nov 2006

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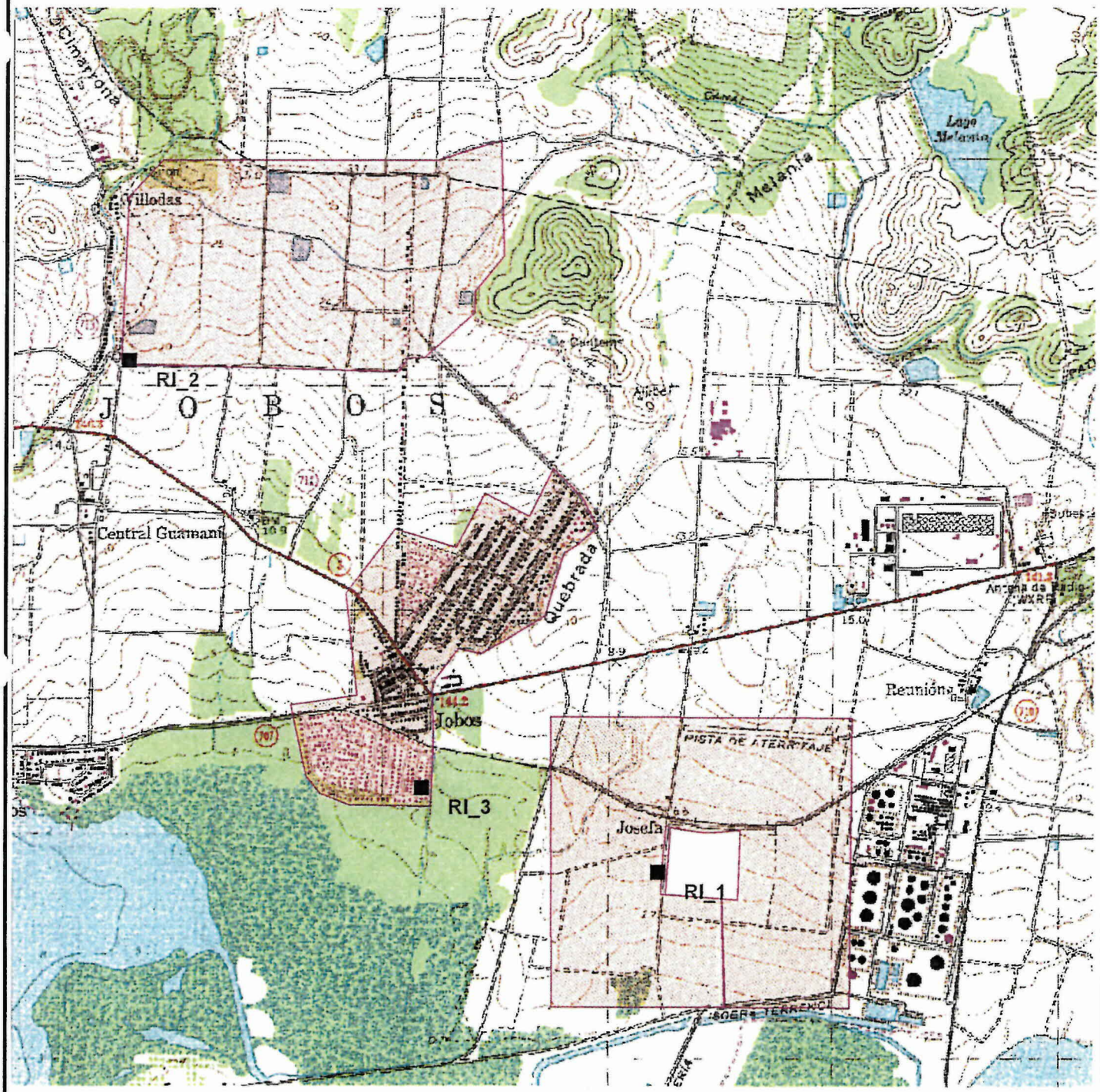
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 4-4
Bahia de Jobos Watershed

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



LEGEND

■ Receptor Locations

Scale	Date
None	Nov 2006

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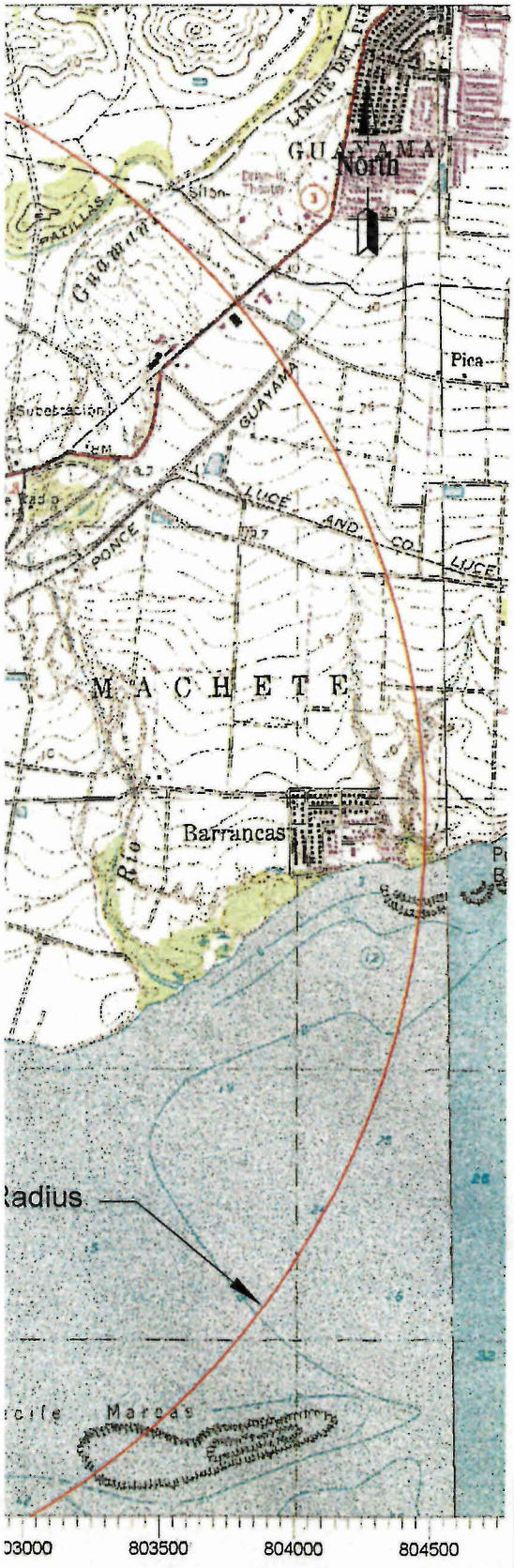
Figure 4-5
Receptor Locations

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



NOTE

The emissions center has been located at the middle point of a line connecting the stack and scrubber.
The UTM coordinates are X:801476 and Y:1986909

Scale	Date
Indicated	Nov 2006

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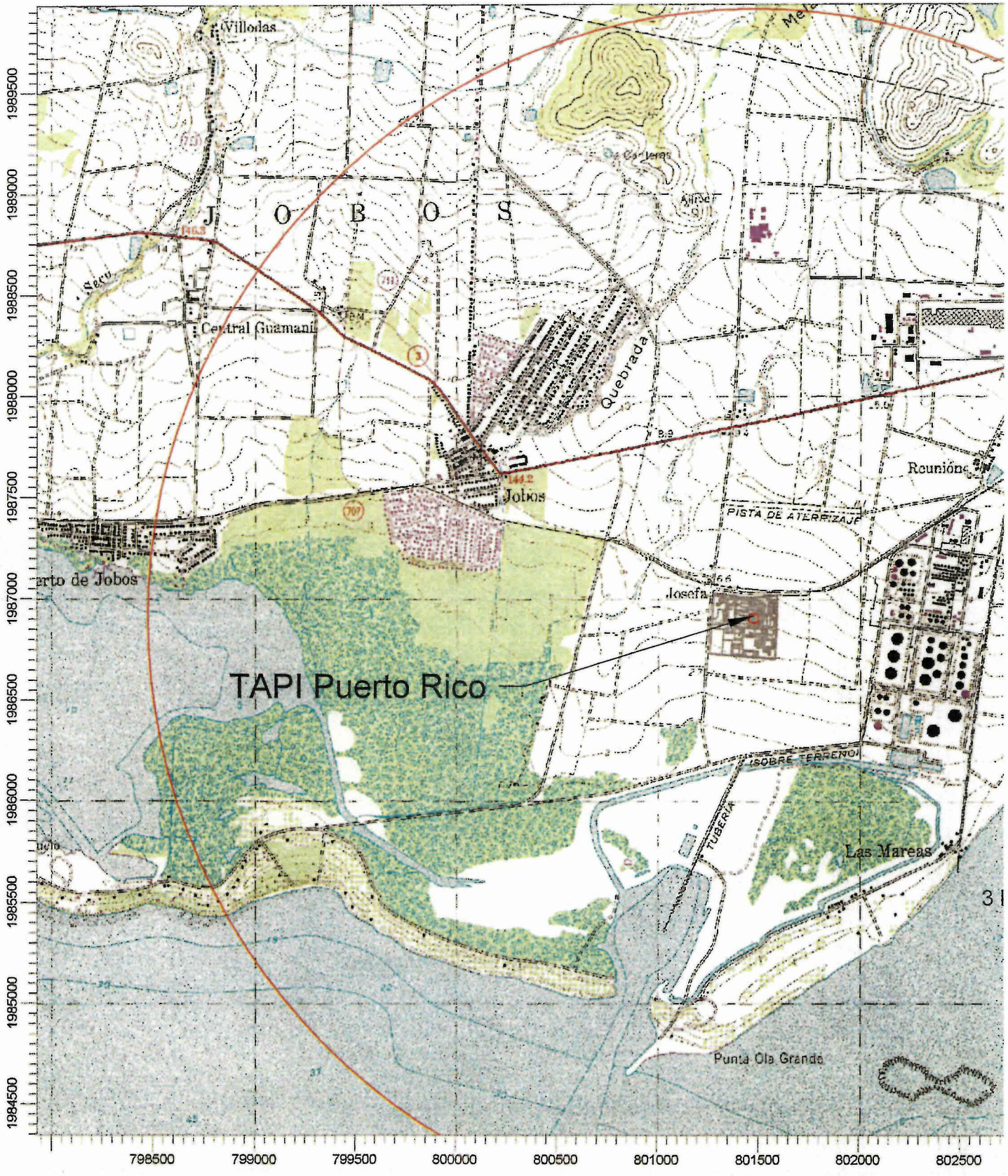
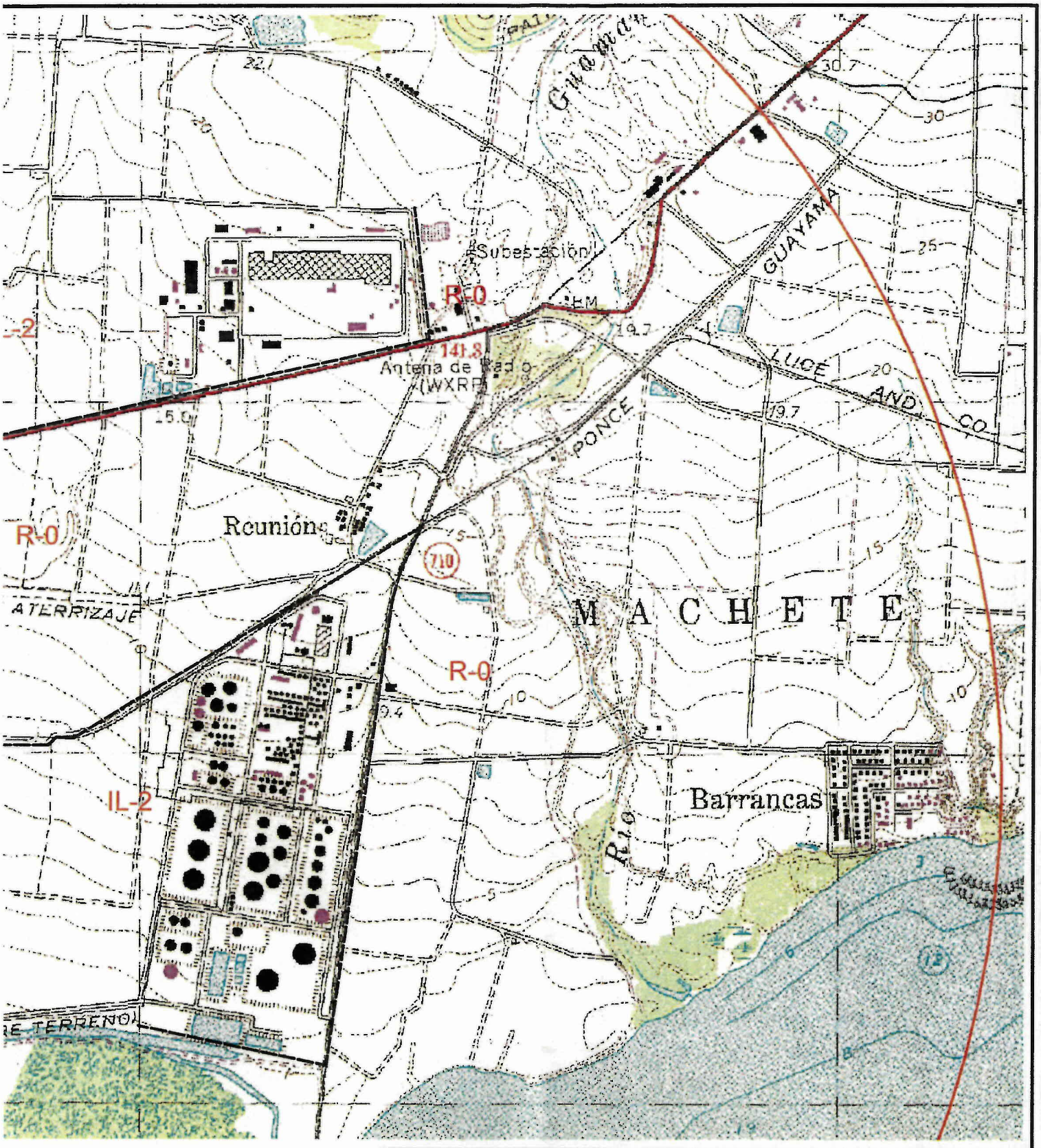
Figure 4-1

Facility Location and Land Uses
3 km Radius From Emission Center

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico


Villodas
J O B O S
Central Guamaní
Quebrada
Jobos
PISTA DE ATERRIZAJE
Josefa
TAPI Puerto Rico
SOBRE TERRENO
TUBERIA
Las Mareas
Punta Ola Grande
1989500
1989000
1988500
1988000
1987500
1987000
1986500
1986000
1985500
1985000
1984500
798500
799000
799500
800000
800500
801000
801500
802000
802500



Scale	Date
Indicated	Nov 2006

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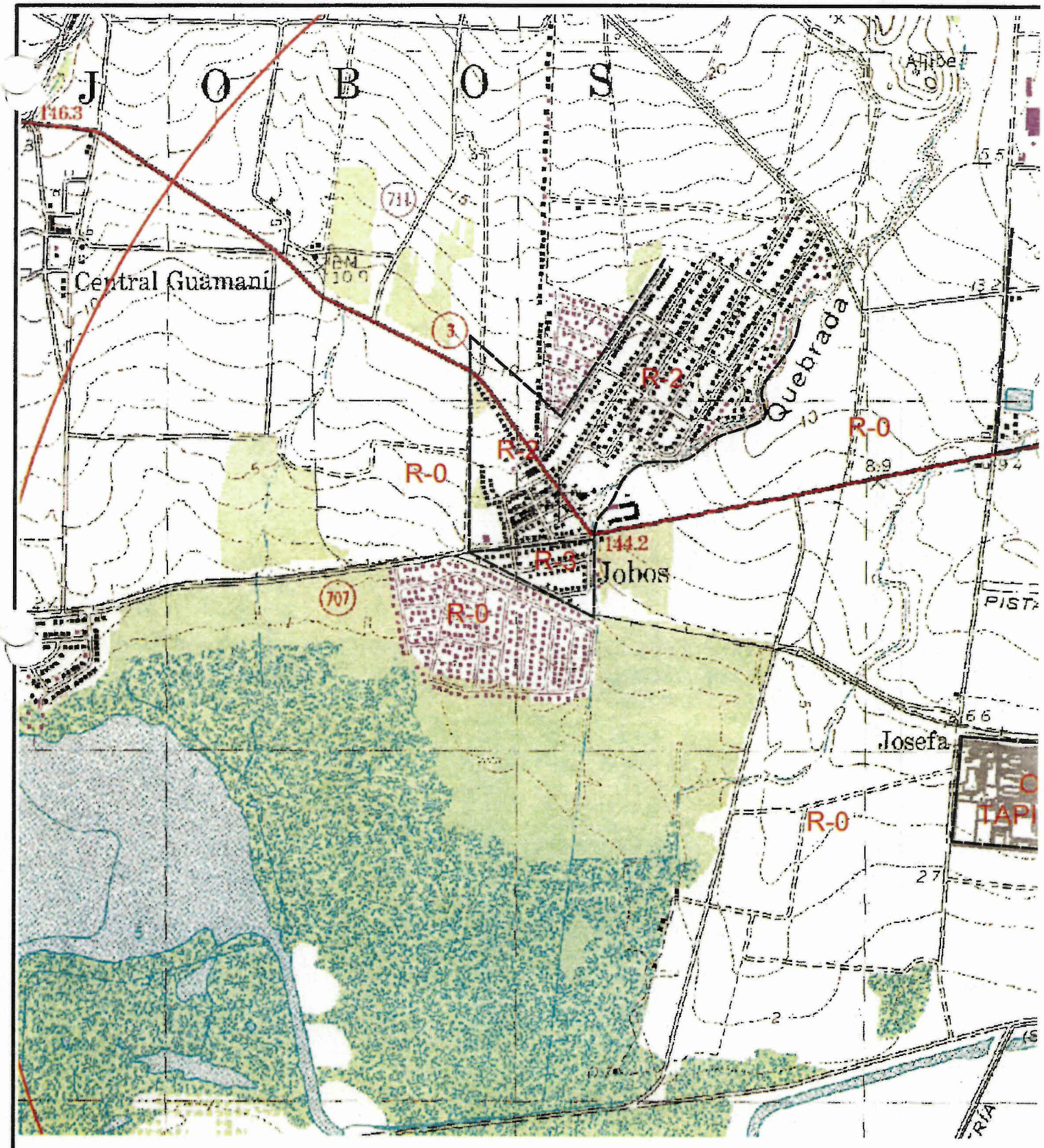
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 4-2
Zoning Map - 3 Km radius

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico



NOTES

1. R-0, R-2, R-3 designate residential land use.
   IL-2 designates industrial land use.

NOTE

The emissions center has been located at the middle point of a line connecting the stack and scrubber.
The UTM coordinates are X:801476 and Y:1986909

0 2 4
km

Scale	Date
Indicated	Nov 2006

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SAN JUAN, PUERTO RICO

Figure 4-3

Facilty Location and Land Uses
10 km Radius From Emission Center

TAPI Puerto Rico, Inc.
Guayama, Puerto Rico


1996000
1994000
1992000
1990000
1988000
1986000
1984000
1982000
792000
794000
796000
798000
800000
802000
804000
AGUIRRE
POZO HONDO
MARIMETE
MAR CARIBE
TAPI Puerto Rico

2
Sca

Appendices A - H